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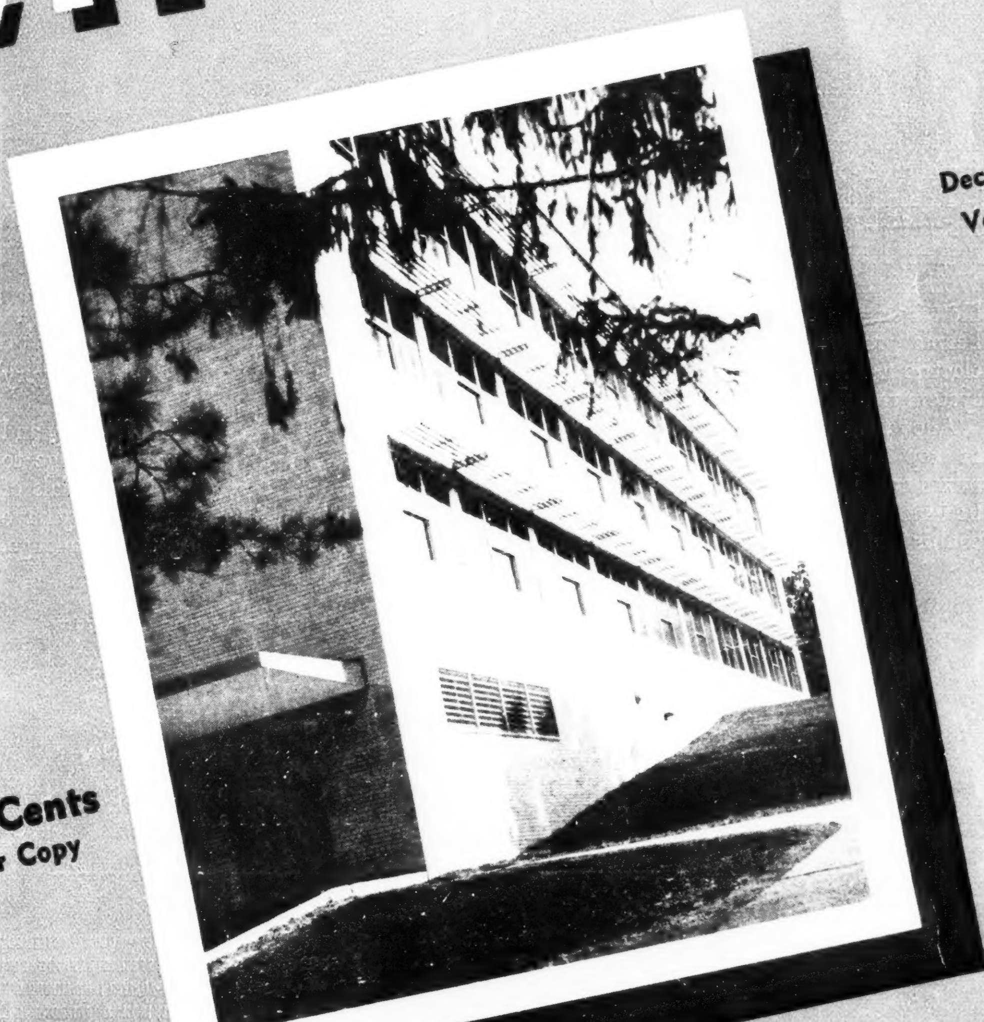

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Cover: Looking north and east at the Cornell Laboratory of Nuclear Studies, dedicated October 7, 1948.

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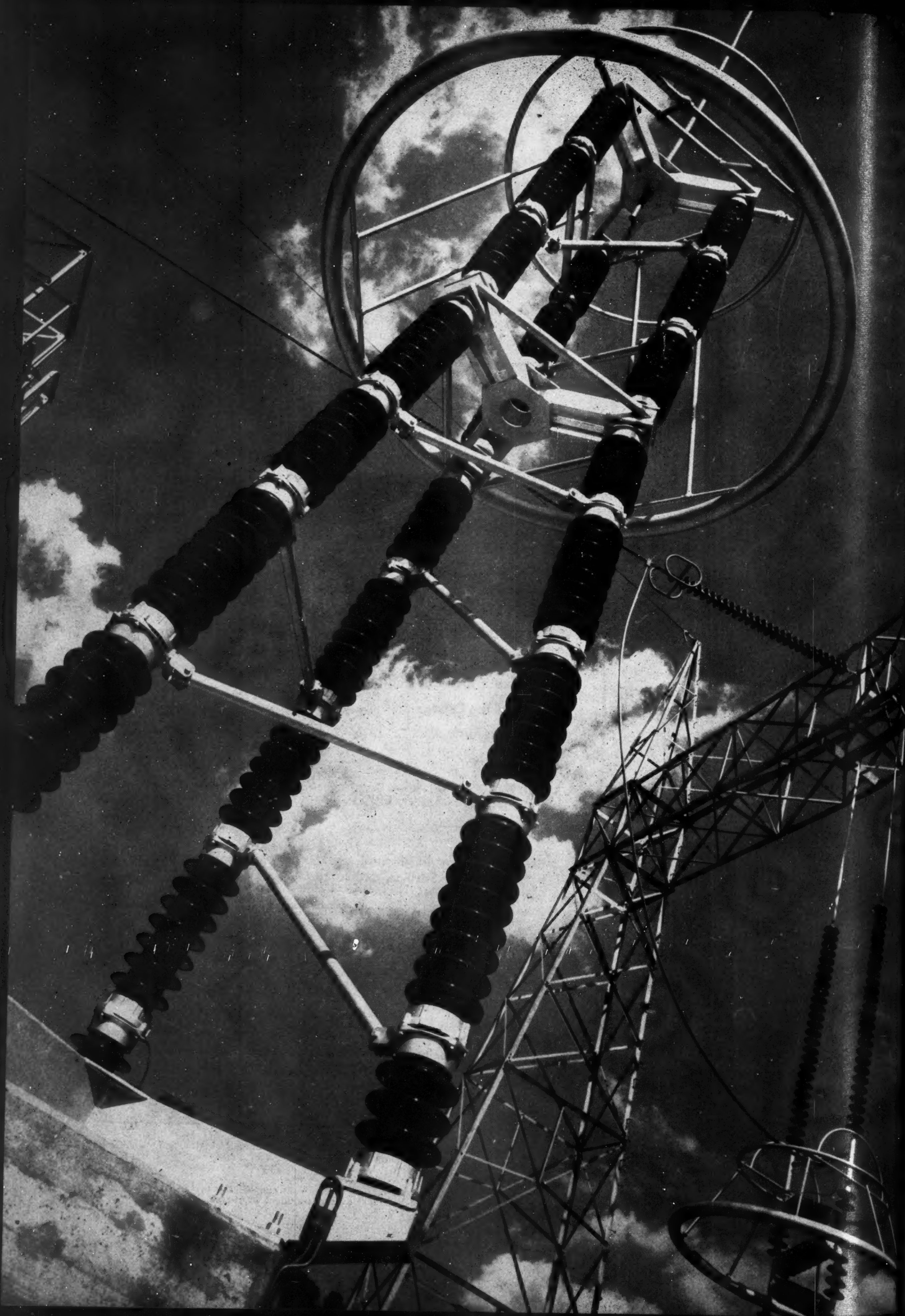
This issue, December, 1948.



Engineering at Cornell

Soils Testing Laboratory

By PROFESSOR BENJAMIN K. HOUGH

A RECENT development in the School of Civil Engineering is the provision of greatly expanded facilities for student instruction in soil testing for engineering purposes. The new facilities are located in the Temporary Building on Forest Home Road which was erected last year by the Federal Public Housing Authority and which now houses the Graduate School of Aeronautical Engineering and the Civil Engineering classrooms and offices for the Hydraulics and Soil Mechanics Engineering instructing staff. This building was originally a Navy barracks located at Davisville, Rhode Island.

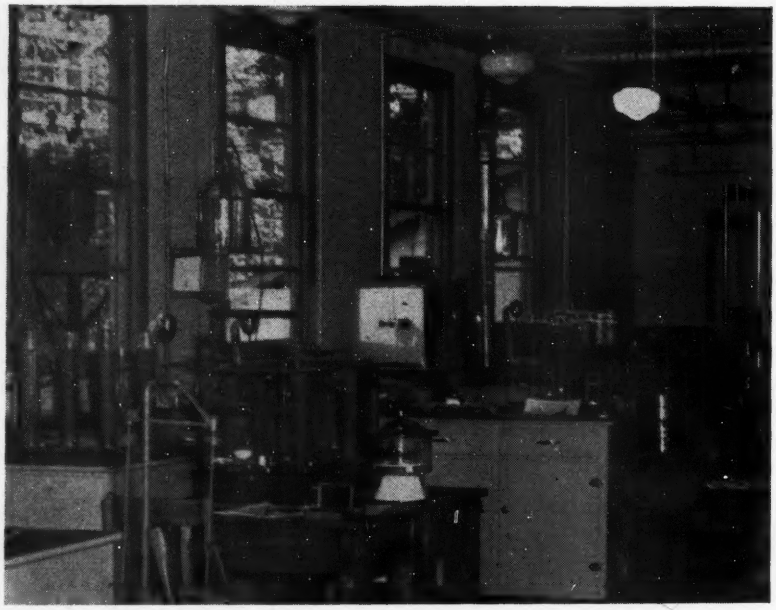
Five identically equipped testing stations, each of which can accommodate five or six students, comprise the new Soils Labratory. These facilities provide adequate space for individual experimentation although enrollment per section has increased three-fold over the pre-war figure.

Lab In Operation This Term

Before the War, the C.E. Soils Laboratory was housed in the basement of Lincoln Hall in quarters designed to accommodate the small classes of that period. Post-war enrollments raised the registration in the Soils Engineering courses to sections of more than 50 men while similar increases took place in sections registered for Sanitary Engineering and other courses. The Lincoln Hall space was, therefore, used to augment laboratory facilities for Sanitary Engineering, and an entirely new Soils Laboratory was projected for the newly acquired space in Temporary Building No. 1. This new laboratory went into operation for the first time at the beginning of the fall term, 1948. It represents a part of the general improvement of C.E. and other Engineering School facilities advocated by the Dean of Engineering.

Large non-university soil testing laboratories have in the past been constructed for maximum efficiency in what might be termed production testing, namely, the conduct of large numbers of tests at the same time. The almost equally large facilities now in use at Cornell were designed for maximum efficiency in a different respect, namely, student instruction, and hence, present a marked contrast to the layout of commercial laboratories with their characteristic grouping of equipment for minimum lost time and motion. The basic plan of organization of the Cornell Laboratory is to spread out the testing equipment so that small groups may work on assigned experiments independently and without interference. The Laboratory space has been divided into five identically equipped testing stations, each of which can accommodate approximately five students. Sections of 25 to 30 men, in contrast to the pre-war figure of 8 to 10 men, may therefore be accommo-

Shown installed on the 500,000-volt test transmission line (see page 9) of the American Gas & Electric Company's central system is the world's largest lightning arrester. The three 29-foot high legs of this Westinghouse-built arrester gives lightning an easy path to the ground so as to prevent instrument damage.
—Courtesty Westinghouse Electric Corp.



Testing stations in the new soils laboratory opened this fall term in the Temporary Building on Forest Home Road, overlooking Beebe Lake.

dated during a single laboratory period without undue crowding and with opportunity for each man to perform experiments individually.

At the opening of the fall term, facilities were available for conducting what are generally termed routine soil classification tests. These include specific gravity determination, mechanical analysis by sieve and hydrometer methods, water content and void ratio determinations, Atterberg Limits of Consistency, moisture density relations, etc. The present classes are now more than halfway through these experiments. Equipment was delivered in November for conducting direct and triaxial shear tests, permeability and consolidation tests. Certain features of the shear and consolidation testing equipment are unique and are described below.

It is planned to furnish each testing station with what is essentially a small scale testing machine which in principle is not unlike the equipment used for applying loads in a standard testing materials laboratory in experiments on specimens of steel, concrete and wood. To conserve space each machine is so designed and constructed that it can be used for any soil test in which load application is required, and for this reason the machines will be called Universal Soil Test Loading Machines. This in itself is a departure from the practice in commercial laboratories where the loading machines are designed and constructed for one type of test only, and where three single purpose machines would consequently be required in place of each more versatile unit in the Cornell Laboratory.

The new machines apply and weigh vertical loads with a pneumatic diaphragm type pressure cell and for the so-called direct shear test can also apply a horizontal load by a mechanical system. The pneumatic diaphragm makes possible a certain amount of automatic load maintenance simulating deadweight loading.

A second and more important distinction is that the machines are so designed that in the direct shear test the effect of change in area of the shear plane can be given adequate consideration. It is believed that these are the first machines to be constructed on this principle. To accomplish this, the machines are so designed that the normal load on the shear plane can be gradually reduced in direct proportion to the decrease in shearing area in order to maintain a constant normal stress. The machine also automatically maintains the normal load in the center of the shear plane by displacing both parts of the specimen equal distances in opposite directions.

Engineers who are familiar with materials testing are generally aware of the fact that the change in cross-sectional area of specimens of ordinary engineering material, particularly in tension tests, must be considered at least in calculating the ultimate strength of the material. Use of the original or nominal area in calculating stress at failure in such cases is known to be inaccurate. A similar situation exists in direct shear tests on soil specimens, but to a much greater degree since the amount of strain required to develop full shearing resistance in soil is greater than the strain produced in ductile or brittle materials at failure. Little attention has been given to this subject in direct shear tests to date, and it is still common practice to compute stress on the basis of the original shear plane area even though strains in excess of 10% may be involved.

Preliminary tests with the new type loading machines indicate that quite different concepts of the stress-strain relations in soil may be established and that more accurate determinations of shearing resistance may be possible.

First Phase of a Plan

The above described facilities for student instruction constitute the first phase of a plan for ultimate development of the entire space allotted for the new Soils Laboratory. Plans for future development include the provision of facilities for research by staff and graduate students and plans for additional general purpose facilities for both research and student instruction. Certain research is already in progress with temporary facilities, both by students and by the research staff, of a Government sponsored soils research program. Several undergraduates have discovered a provision in the Announcement of the College of Engineering which permits them to substitute a thesis for a required engineering elective and have taken advantage of this rule by doing thesis work in the new Soils Laboratory. There is some evi-

(*Concluded on page* 40)

Test Project for 500,000 Volt Power Transmission

By HAROLD M. SAWYER, M.E. '11

Photographs courtesy American Gas and Electric Service Corporation

On the frontispiece of the CORNELL ENGINEER for April, 1948, there appeared a photograph of some unusual electrical equipment over the caption: "Full scale equipment presently being used for power transmission tests."

Behind this photograph lies a story which a brief caption cannot even begin to tell. It is a story of research into electrical phenomena on a scale never before attempted. It is a story of the cooperation between one of the large power companies in the country and a group of prominent manufacturers to determine, through practical research, how the art of electric power transmission can be more economically developed.

A series of papers has been given before the A.I.E.E.[1] describing the theoretical aspects of what is being attempted and the apparatus being used. The testing, however, will extend over a period of three years and there is as yet to be made the report on the results of the tests. This report should be looked forward to with great interest by power engineers, people associated with the electrical industry and users of power all over the world. The results will have a profound influence on the power industry, whether the energy source is falling water, fuel or atomic fission, and will greatly affect the price the consumer will pay for electric energy and the quantities in which he will be able to use it.

Perhaps the objectives of the project can best be described in the words of Mr. Philip Sporn, President of American Gas and Electric Service Corporation, who spoke as follows when he inaugurated the testing operation on October 1, 1947:

Objectives of the Project

"We are setting new production records almost daily in many fields of activity. Power—electric power—is one of them. As a matter of fact, we are doing it through power. Thus, our national production of electric energy recently passed the astonishing weekly figure of five billion kilowatt hours, and it is going higher.

"With increased uses and new loads and with increased generation facilities, there come demands for new dimensions in transmission. More transmssion is needed to transmit the much larger blocks of power from the generation to the load centers. Thus, systems operating over an extensive area will re-

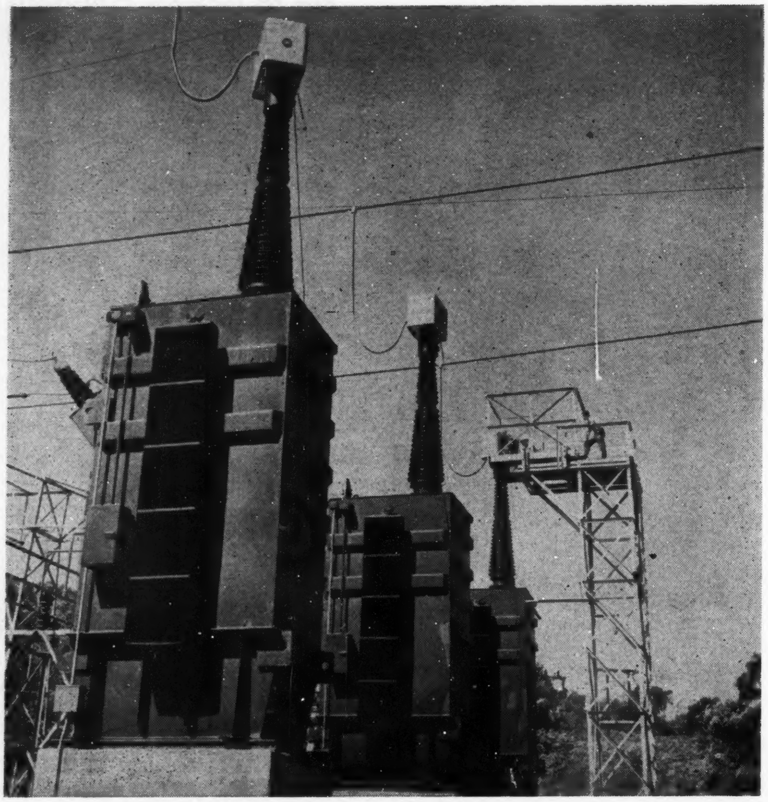
1. *A.I.E.E. Transactions*, Vol. 66, 1947, Proceedings T7241-T7246, incl.

THE AUTHOR

Harold M. Sawyer, Vice-President of American Gas and Electric Company, and Vice-President and Director of its operating subsidiaries, graduated from Cornell University in 1911 with a M.E. degree, although majoring in electrical engineering. He has been associated with the American Gas and Electric Company system since 1911. In 1924 he became general contract agent in charge of new business activities. He was elected Vice-President in 1928 and is still in charge of all commercial activities.

Mr. Sawyer has taken active part in the work of various committees of the electric light and power industry. He is a past president of the Asssociation of Edison Illuminating Companies and has been a participant in the organization of a number of the industry's national activities.

Harold M. Sawyer



Several of the large 500,000 volt transformers employed in the field laboratory. The instruments located in the boxes on the bushings will give full-scale measurements of phenomena experienced at this voltage.

quire vastly increased transmission facilities to provide the proper capacity in their integrating and coordinating networks. The ties between adjoining systems will have to be on a much bigger scale and all of that will require voltages higher than have been utilized heretofore, if the economics of transmission are to be maintained in balance.

Need Data for Over 287,000 Volts

"But before the necessary transmission lines can be designed with a degree of knowledge and precision to bring about economical transmission, more technical information is needed about the characteristics and performance of the phenomena and the materials involved in building lines above the present highest voltage at which lines are operated, namely, 287,000 volts. In particular we need to know the performance and behavior of the air surrounding a high voltage conductor when the conductor is raised to such high voltages. We need to know the performance of the insulators which keep the electric pressure from breaking through and going to ground, instead of staying on the conductors. We need to know what kinds of conductors and what arrangements can best accomplish the transmission purpose at these higher votages; and when we know that, we can design our supporting structures with a degree of accuracy that economy dictates. And finally, we need to have a great deal more information than we have on the performance of a good deal of other equipment that enters into the operation of a high voltage system—the circuit breakers, which are the devices which switch the power on and off; and the lightning arresters, which keep lightning from breaking through and entering the equipment and destroying it; and the transformers themselves, which both raise the pressure of the electric power to the high transmitting voltage, and lower it again to bring it to values that can be handled along highways, on farms and in homes.

"The project, conceived and initiated by the American Gas and Electric Service Corporation, received the enthusiastic support and cooperation of a group of outstanding manufacturers, and I should like to name them here. They are Aluminum Company of America, American Bridge Company, Anaconda Wire & Cable Corporation, General Cable Corporation, General Electric Company, Locke Insulator Corporation, Ohio Brass Company and Westinghouse Electric Corporation. Together we have provided the equipment and facilities and will operate it for the benefit of our own companies, but only nominally so, because essentially the benefits will be available to the entire electric power industry in the United States.

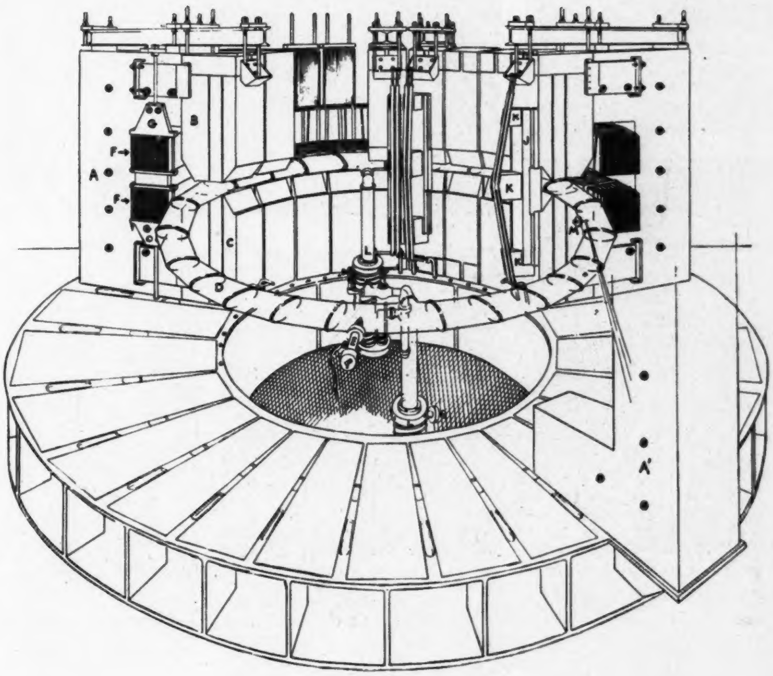
"The field laboratory includes a full-size model of towers, lines and equipment. Nothing is scaled down, because we are operating in a field here where full scale measurements are essential. We are equipped to operate the experimental lines with voltages from 264,000 up to 500,000 volts. This voltage is perhaps higher than any voltage considered practicable at the present time. But in order to determine the factors of practicability, it is necessary to go beyond the practicable range, and it is for this reason that we are planning to go up to 500,000 volts.

(Concluded on page 26)

Observation booth of the 500,000 volt Tidd test project. Tests will be run continuously for three years, and the practical limits of high voltage transmission will be investigated.

Basis of Operation of The New Cornell Synchrotron

Designed and built by members of the Nuclear Studies Lab, the one-half million dollar synchrotron illustrated at right and on the following pages weighs 85 tons, and is 13 feet in diameter and 8 feet high on its concrete base. It will be utilized in a search of "fundamental questions which look beyond the immediate practical problems of today," stated Dr. Isidore I. Rabi, '19, head of the Columbia University physics department, in a dedication ceremony address.



This article presents an explanation in qualitative elementary terms of the process by which the new Cornell University synchrotron will accelerate electrons to 300 million electron volts of kinetic energy, at speeds closely approaching that of light. The accompanying cutaway drawing, obtained from the Laboratory of Nuclear Studies, shows the component parts quite clearly, and will be referred to in this discussion.

The basis of design of all such accelerators is to increase the energy of the particles in many successive steps. Obtaining a single 300 million volt potential in one step would be impossible, if only from the standpoint of insulation. Thus the electrons move in a short circular chamber (D), which is made of 24 short pyrex tubes of elliptical cross-section, joined by rubber gaskets and evacuated to about one billionth of an atmosphere. The vacuum is maintained by an oil diffusion pump (L), backed by a mechanical pump not shown. The accelerating chamber, or "doughnut," is mounted in a ring of 24 large laminated "C" magnets (A) facing inward and fitted with pole pieces (B) which terminate just above and below the "doughnut." Joining the pole pieces of each magnet is a flux bar (J) which passes inside the "doughnut" and is held on by steel straps and insulating blocks (K). The magnet coils (F) run all the way around just outside the "doughnut" and above and below it, in the windows formed by the "Dees." There are 360 turns of very heavy wire, 180 in each coil. The current in the coils is 60 cycle alternating, driven at 13,000 volts RMS by running the coils to resonance with a roomful of condensers. Th magnetic field thus produced rises from zero to its maximum value in one fourth of each alternating current cycle, and it is during this 1/240 secon that the electrons are accelerated. They are introduced at the start of th cycle by a 70,000 volt electon gun at E, and the machine begins to operat as a betatron. This means that the rate of increase of the magnetic fiela accelerates the electrons tangentially, while the existence of the field holds them in the orbit of one meter radius. This type of operation increases the energy of the electons to 2 million electron volts, abbreviated 2 Mev. At this energy, they are within a few per cent of the speed of light, and the addition of more energy serves only to increase their mass. This means that their velocity around the "doughnut" remains substantially constant at about 50 million revolutions per second, however much energy is added. The flux bars, which have controlled the field by shorting out much of it, now saturate and the full strength of the field is available for holding the electrons in the orbit while they are accelerated electrostatically. This is done by the resonator section of the "doughnut," to which is applied a high voltage potential at 50 megacycles, to give the electrons a "kick" on every revolution. This is the period of synchrotron operation, which increases the energy of the electrons to the full 300 Mev. During the time it spends in the machine an electron travels nearly a thousand miles.

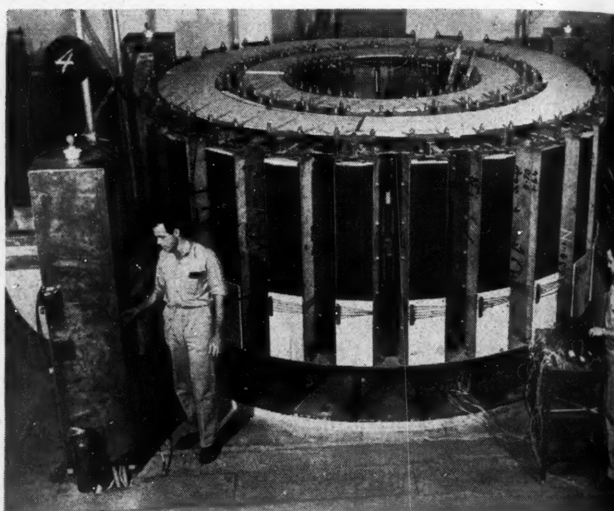
Production of Gamma Rays Overcomes Electron Withdrawal Difficulty

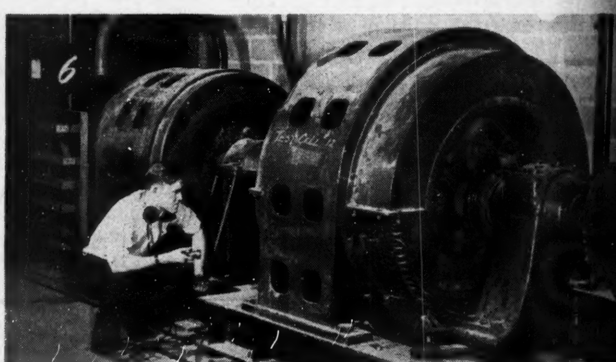
It will be very difficult to withdraw the electrons themselves from the machine, since charged particles would not pass through the large magnetic fields in the machine in anything approaching a straight line. What will be done is to place a target, probably a tungsten rod, in the "doughnut" at M. This will produce very high frequency gamma rays which will pass straight out of the machine through the opening in an extra large magnet A'. These rays will be used to perform experiments with metal targets, the Wilson cloud chamber, and many other delicate instruments.

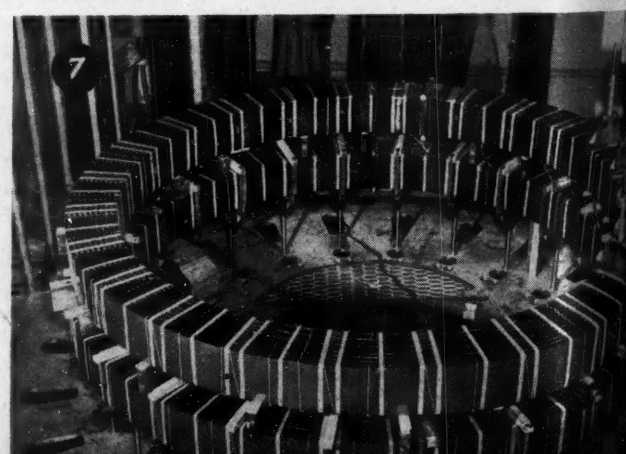
CORNELL'S

By VICTOR K. PARÉ, EP '51

ON October 7, 1948, Cornell's new Laboratory of Nuclear Studies was dedicated. Among the most interesting and valuable activities of the day were the guided tours of the building, held both for the press and for the public. Those who took advantage of these trips







1. Pictured at the ground breaking exercises on March 22, 1947 are from left to right Pres. Edmund E. Day of Cornell Univ., Profs. Franklin A. Long, Hans Bethe, Robert R. Wilson, and Mr. E. K. Graham (former secretary of the University)
2. The Synchrotron Building at the right is nearing completion, while the Nuclear Physics Laboratory can be seen in the background.
3. A general picture of the machine shop in the Nuclear Lab.
4. Testing of the synchrotron in preparation for eventual operation.
5. Reinforced concrete provides a permanent structure to house the synchrotron.
6. A 1000-KW motor generator provides a regulated single phase current for the synchrotron magnets.
7. Magnet coils in position above the base of the machine.
8. A group of people waiting to be taken on a conducted tour of the Nuclear Physics Laboratory on the day of dedication.
9. Profs. B. D. McDaniel and D. R. Corson fitting a section of the pyrex "doughnut" to a wooden mock-up of the pole pieces.
10. Making adjustments on the main control panel for the synchrotron.
11. Assembling the gun which will inject electrons into the "doughnut" at 70 kilowatts energy.

SYNCHROTRON

were rewarded not only by seeing ultramodern construction and strange, ponderous equipment, but by absorbing some of the electrifying atmosphere of an organization preparing to explore a new, almost unmapped field of knowledge. For its readers who were unable to see the new laboratory, the ENGINEER presents, here and now, its own guided tour of the Nuclear Laboratory, in which it will endeavor, by words and pictures, to reproduce the laboratory's appearance and atmosphere.

We meet on a brisk, sunny morning between the laboratory and Savage Hall, the nutrition building, which is located just north of Bailey Hall. When the entire group has gathered, our guide takes us into the lobby at the east end of the first

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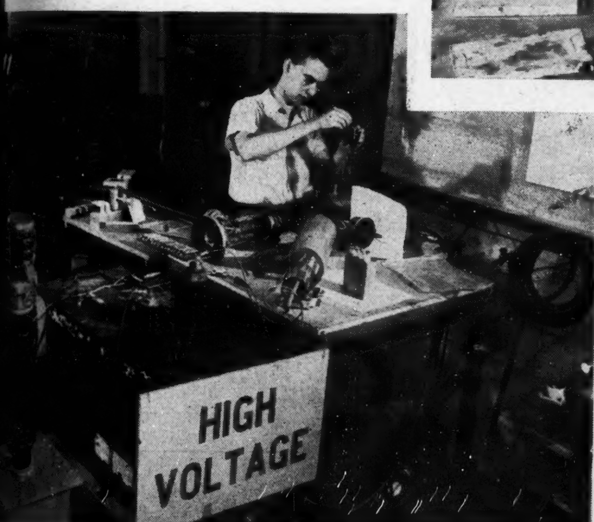
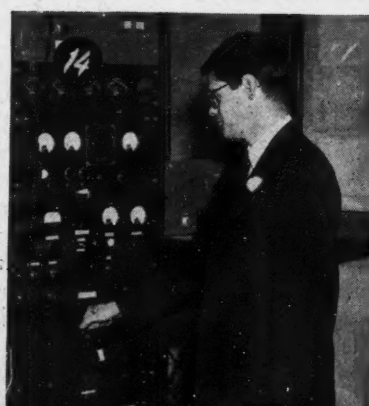




12. The "doughnut" assembled on a test stand to check its ability to hold vacuum.

13. Gathered for dedication of the Laboratory are from left to right, Mr. Neal Dow Becker and Mr. J. Carlton Ward Jr., members of the Board of Trustees; Prof. I. I. Rabi of Columbia University and principal dedication speaker; Pres. Edmund E. Day of Cornell University; Prof. Robert R. Wilson and Dr. R. F. Bacher.

14. Prof. Robert R. Wilson adjusts a variac on the control panel for the linear acceleration.

RADIOACTIVITY IS ALL
BUT SYNONYMOUS WITH . . .

Geiger Counters

By ALFRED BLUMSTEIN, EP '51

WHERE in the world did I put that vial of radium?" After several minutes of frantic searching for the costly vial, the "absent-minded professor" picks up a black oblong box resembling a portable radio with a set of earphones attached. He probes the box this way and that, listening to the ticking in his earphones. Suddenly, the ticking approaches a steady hum. He aims and follows his instrument to the waste-paper basket. Brushing aside some scratch paper, our professor comes up with his precious vial which, were it not for the searching eye of this detecting instrument of his, might have ended up as extremely expensive incinerator fuel—to the tune of about $70 per milligram.

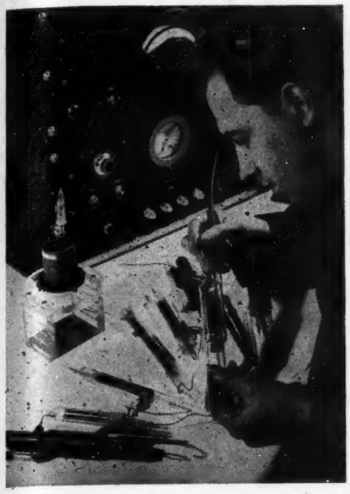
This wonder instrument of our professor was the Geiger counter, an instrument devised about forty years ago to detect and count radioactive particles. The essential parts of the instrument, as shown in Fig. 1, are a metal cylinder, usually copper, and a thin tungsten wire running along the axis of the cylinder, both of which are enclosed in a glass tube. The atmosphere inside the tube consists of a mixture of gases at a pressure of about ten centimeters of mercury. A delicate electrical balance is maintained between the wire and the cylinder by a potential difference of between 300 and 5,000 volts, just less than enough to cause the current to break down the gap. The actual voltage used in any specific case is determined by several factors, including type and pressure of the gas used and the geometrical aspects of the counter itself.

Portable Geiger counter, which may be carried about for use in the field or at different points in the laboratory. The counter tube is shown in the foreground.
—Courtesy El-Tronics

Size Varies According To Use

The sizes of Geiger counters vary within very wide limits, depending on the specific problem for which it is being used. Counters have been made as short as 9 mm. and as long as a meter. Although the average radius is about 30 mm., sizes have ranged from 4 mm. up to 75 mm., and almost any dimension is achievable if the nature of the problem being studied warrants the job of construction.

The principle of the counter is based on the ability of certain particles to ionize a gas in the presence of an electric field. When a radioactive particle enters the counter, it is accelerated toward the central wire by the electrical field. Since the field varies inversely as the distance from the wire, it is only in the area immediately surrounding the wire (within a thousandth of an inch of it) that the initiating particle acquires sufficient velocity to ionize the gas. Thus, in this area is produced a sheath of ions formed in the ionization avalanche which was initiated by the entering particle. The negative ions, or electrons, collect instantaneously at the central wire since it is made the anode of the system. The positive ions then drift comparatively slowly towards the negative cylinder, causing the positive potential on the wire to gradually decrease until it would theoretically become a minimum when all the ions reach the cylinder. As the potential drops it will eventually reach a point where there is not enough of an electric field to impart to the incident particles sufficient velocity to enable them to produce ionization in the gas. The time when this situation exists is known as the "dead time" of the counter—that time when an incident particle can produce no ioniza-



An assortment of atomic counters, with the receiver in the background. The physicist is holding a detector specially designed to locate "tagged atoms" in liquid solutions.

—Courtesy Westinghouse

tion due to the drop in the field strength.

As the potential drops, the charge is eventually restored by the battery through the leakage resistance shown in Fig. 1. If this resistance is high, as the potential drops, the effect of the battery trying to maintain the original voltage will eventually overcome the resistance and the charge will leak through, finally restoring the original potential. On the other hand, if the resistance is small, all the while that the potential is decreasing, the battery is able to maintain a voltage close to the original much more easily. Counters with a low resistance are, therefore, the ones that are used more frequently because the "dead time" is reduced considerably. (It should be noted here that the notion of time to overcome the resistance is purely relative. Actually, the maximum "dead time" is of the order of one hundredth of a second.)

Pulse Amplification Unnecessary

The pulse produced by the change in the voltage of the central wire system is generally large enough so that it need not be amplified, and it may thus be made to record directly as a tick in an earphone, graphically, or as a movement on an oscilloscope. This ability for direct recording is advantageous in that it eliminates the error that would be introduced in passing the pulse through an amplifier.

A pulse may be produced by either one, one thousand, or one billion particles entering the tube, so that the Geiger counter is unable to quantitatively analyze a source if all the particles emitted enter the tube simultaneously. However, if there is a difference in the time of entry of about one hundredth of a second between two particles there will be two pulses. Thus, the Geiger counter is capable of recording several hundred particles per second, depending on the length of the "dead time" of the particular counter, which, in turn, is dependent on the value of the leakage resistance.

Now that we have obtained a quantitative determination of our radioactive source, we would also like a qualitative analysis. We would like to know whether our source is emitting cosmic rays, x-rays, nuclear particles such as alpha, beta, or gamma rays, or any of the other particles to which the Geiger counter is sensitive. This analysis is not always possible, but when it can be done it is generally accomplished by placing suitable screens or filters between the tube and the source of radiation. For instance, if there is a source which radiates beta and gamma rays and which has a thin sheet of metal placed in front of it, the recorded number of particles will drop sharply from the reading without the screen because of the absorption of the beta rays by the metal. As the thickness of the metal is increased, the counting rate will drop less rapidly until the point where nearly all the beta rays have been absorbed, and then the rate will level off because of the only slight absorption of the remaining gamma rays.

Particle Distinguishment

Another method, which is used to distinguish between alpha and beta particles, is through variation of the potential between the cylinder and the wire. At certain low voltages, only alpha particles can be detected, while at higher voltages both alpha and beta particles affect the instrument. Thus, if the voltage is increased without an increase in count, the entering charge consisted of only alpha particles. If, however, the count increases with the voltage, there were also beta particles present. (These conclusions assume that the source can emit only alpha and beta particles.)

An entirely different method is used to detect the presence of neutrons, particles which, by themselves, are not able to ionize the gas and thus have no effect on the Geiger counter. In this case, use is made of the fact that neutrons may enter nuclear processes with certain atoms resulting in the liberation of ionizing particles. If the gas used in the Geiger tube is boron trifluoride, the neutrons entering the tube will interact with the boron atoms leading to the formation of alpha particles, which can then affect the counter. Thus, the neutrons can be counted indirectly by

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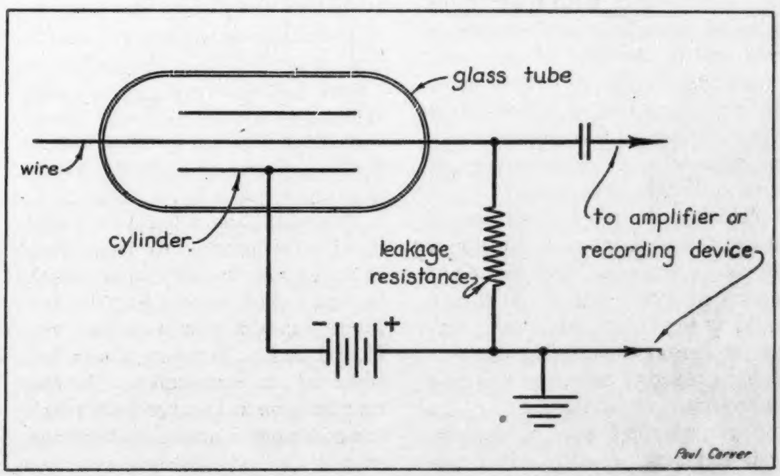
Fig. 1. Schematic drawing of the Geiger counter.



Faculty Introductions

A combined teaching record of a century and a quarter at Cornell-- and still going strong

Prof. Ballard

Prof. W. C. Ballard

Professor Ballard is the senior member of the staff of the Electrical Engineering College. He has his office on the second floor of Franklin Hall. Seated behind a long table well covered with engineering texts, papers, and report folders, Professor Ballard can usually be found absorbed in the work at hand. Rising from his chair, his appearance is pleasant. Of medium height, his handshake is friendly; his voice is soft and flowing; his thoughts are clearly expressed. With thirty-eight years of experience in the teaching field and in the field of industrial consulting, Professor Ballard spins an interesting tale of bygone days when mechanical and civil engineering degrees were the only two offered to fledgling engineers.

Professor Ballard entered Cornell in the fall of 1906 as a student in the Sibley School of Mechanical Engineering. Fresh out of Baltimore City College, an advanced high school at that time, college life was as big a mystery to him as it is now to any young freshman.

Receiving the Degree of Mechanical Engineer in 1910, Professor Ballard nevertheless specialized in the electrical engineering field during his four years here. His first job was with the Bell Telephone Co. His next step brought him back to Cornell as an instructor and he has been here, with the exceptions of leaves of absence and consulting jobs, ever since. He married an Ithaca girl and has three married daughters.

Professor Ballard's first love has always been in the communication's field. Back in 1915, when vacuum tubes were first beginning to appear on the commercial market, he and his colleagues were making their own vacuum tubes in the old vacuum tube lab in the basement of Franklin Hall. Many a Cornell tube went into early receivers.

The first Ithaca broadcasting station was powered by a 5 kilowatt transmitter. With no federal regulations until after 1912, it was a free-for-all among enterprising young radio enthusiasts as to output frequencies and call letters. Station WEAI became the first licensed station in Ithaca and served under the same call letters until 1929. Professor Ballard comments that they only operated the station a few hours each week, or long enough to keep their license.

After 1929, arrangements were made with the Elmira Star Gazette as to setting up studios and broadcasting as WESG with studios in Elmira. Came 1940 and Ithaca once again maintained studios, broadcasting under the familiar letters WHCU (home of Cornell University).

Professor Ballard has been called in on many patent litigations. Perhaps the best known case in which he was a chief witness was the Fox Films episode which reached the United States Supreme Court before final action was taken. Fluorescent lighting is another field which has consumed much of his time and efforts.

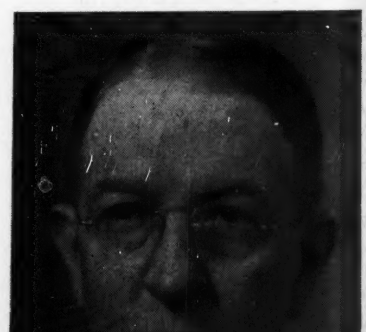
Professor Ballard is at present instructing both undergraduate and graduate students in the electrical engineering college. Telephone and telegraph systems, electromagnetic waves, and patent laws are courses which he is teaching. His students remark that "he really knows his stuff."

Prof. Paul H. Underwood

Paul Halladay Underwood, Professor of Surveying, has for many years been a familiar figure to civil engineering students at Cornell. A native of the Finger Lakes region of New York, Professor Underwood attended Cornell and graduated from the School of Civil Engineering in 1907. While in college, he was elected to Chi Epsilon, honorary CE society.

During the summer following his graduation he was employed as a rodman by the New York State Department of Highway and Canal Surveys. In September of 1907, he returned to Cornell as an instructor in Civil Engineering and since that time he has been continuously asso-

Prof. Underwood



ciated with the school. From February to September of 1911, while on leave of absence from Cornell, Professor Underwood worked as Assistant Engineer with the Isthmian Canal Commission in Culebra, Panama, doing survey computations, mapping, and office operations in connection with the building of the canal.

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Prof. Charles C. Winding

In keeping with the idea that the School of Chemical and Metallurgical Engineering is better characterized by its personalities than by its well equipped plant, let us look for a moment at its young and capable Assistant Director, Professor

Prof. Winding

Charles C. Winding. Certainly Olin Hall would not carry its customary air of purposeful activity were he not often seen striding down the hall, sleeves rolled up and determined look in his eye.

First interested in electricity and radio, Professor Winding enrolled as a physics major in the University of Minnesota, but transferred to chemical engineering after his second year as his interest in chemistry grew. Graduating with the degree of Bachelor of Chemical Engineering in 1931, he remained at Minnesota for four more years instructing in unit operations and studying toward the degree of Doctor of Philosophy which he received in 1935, just before coming to Cornell.

Professor Winding realized an old ambition when he came to Cornell as an instructor in chemical engineering, for he had wanted to at-

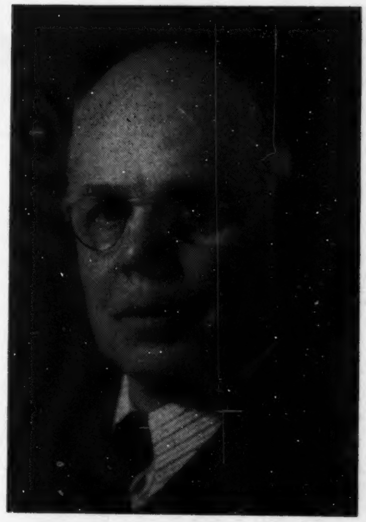
(*Concluded on page* 32)

Prof. Walter R. Cornell

For almost forty years Professor Walter R. Cornell has been grounding engineering undergraduates in mechanics, strength of materials, and hydraulics—an engineer's basic tools. The success of Prof. Cornell's teaching efforts since he came to this University is directly reflected in the achievements of graduate M.E.'s since then, and in the ever-rising esteem in which industry holds the M.E. School, because throughout his stay here Prof. Cornell has been providing students with the basic foundation upon which to build their engineering careers.

After receiving a B.S. from Rutgers University in 1907, and spending two years at Michigan Ag., Prof. Cornell came to Cornell in 1909, where, for a year, he taught in Lincoln Hall under the late "Poppy" Church. He received the degree of C.E. in 1915. In 1910, when a department of mechanics was created in Sibley College, he moved to Sibley College, under Prof. E. H. Wood, who was placed in charge of this new department. Ever since then Prof. Cornell has been teaching in Sibley, and has risen to be a professor of mechanics of engineering.

Prof. Cornell has for many years been prominent on several administrative committees of the M.E. School. He is at present chairman of the M.E. School's scholarship committee, which selects loan and scholarship winners and also decides the rules for determining the fate of those whose work is unsatisfactory. Prof. Cornell is also secretary of the engineering division of the Graduate School, and secretary of the mechanical engineering section of the division. During the war Prof. Cornell served on the "General Committee" in Sibley under Prof. Barnard, assisting the direc-



Prof. Cornell

tor with administrative work. Under Dean Kimball Prof. Cornell was for several years class advisor for the whole sophomore class (about 200 men), in which capacity he made out schedules for the entire class in one day of registration.

To Prof. Cornell, the subjects of mechanics and strength of materials are merely means to an end, the end being to teach students to think problems through logically, instead of just substituting in the formulas and grinding out an answer. Prof. Cornell says that students usually don't appreciate the importance of the reasoning processes taught in mechanics until they are a little older and, presumably, wiser. For that reason he thinks that veterans may have an advantage over the younger fellows when studying mechanics because, in general, they see more readily the broad objective of the course.

Thus has Prof. Cornell served the University and the engineering profession—almost forty years of prodding, testing, and molding the minds of would-be engineers; puzzling his students with his pointed questions; and disarming them with his ready smile. Teaching twelve months a year all the long war years has left him tired; and yet each new incoming class of engineers brings a new challenge. All the students who know and respect him hope that he will continue to accept the challenge for many years to come.

Cornell's Honorary and Professional

Freshman, sophomore, junior, senior, and fifth year engineers!

Everyone is past the rush and scurry of those first two months of the school year; the first round of prelims are over; and, at last, a brief breathing spell is in order. Every student engineer should not only be familiar with the professional, honorary, and social societies within his respective school, but should be striving to attain their ranks from his freshman terms onward.

The Cornell Engineer presents the following brief resumes of the various societies within the Engineering College to better acquaint the undergraduates with the eligibility requirements, purposes, current officers, and future plans for each of the societies.

Tau Beta Pi

The national honorary society for engineering students who have exhibited outstanding scholarship coupled with extra-curricular activities is Tau Beta Pi. It was founded in 1885 and has 48,000 members in the nation. The New York Delta was formed at Cornell in 1910. Seniors in upper fifth of their class and Juniors in the upper eighth of their class are eligible for the semi-annual elections.

This year the officers are: Ray Bump, president; John Darley, vice-president; Stephen Profilet, corresponding secretary; Bill Owen, recording secretary; Ben Hildebrandt, treasurer; and Warren Higgins, cataloger.

Chi Epsilon

This national honorary civil engineering society develops character and ability among engineers by recognizing those characteristics which are fundamental to success. After a student has completed half of his schooling, he is eligible for membership; he must be in the upper third of his class and be elected by a two-thirds vote of the active members. The present officers are: president, William Wade; vice-president, Martin K. Greenfield; secretary-treasurer, James W. Spencer; and associate editor of transcript, Russell N. Meyer. A course survey is being planned to determine the reactions of students to various courses; and a prize to the freshman with best grades will be awarded to recognize scholarship in the freshman class.

Eta Kappa Nu

Eta Kappa Nu was founded at the University of Illinois in 1904 as an honorary society for electrical engineers. Its purpose is to assist its members throughout their lives in becoming better citizens and better men in their profession. Each year the society awards a citation to the outstanding young man in electrical engineering. To be eligible for Eta Kappa Nu, a student must be in the upper quarter of his junior or senior class.

Officers for this year are: Walter J. Plate, president; Gilbert Pinklaim, vice-president; James Ottobre, recording secretary; Robert Russell, corresponding secretary; and Mortimer Levy, treasurer.

Pi Omicron

In 1946, Pi Omicron, was founded at Syracuse as a national honorary society for women engineers. One month later, the Beta Chapter was founded at Cornell. Its purpose is for the advancement of engineering education among women and to initiate and coordinate activities of undergraduate women. This year it has helped to orient freshman women engineers.

This year's officers are Marilyn Thatcher, president; Barbara Peters, vice-president; and Claire Johnson, secretary-treasurer.

Kappa Tau Chi

Kappa Tau Chi has several aims, chief among which are to promote faculty-student relations and to make contributions toward the solution of faculty-student problems which affect students participating in the affairs of the Mechanical Engineering College. The application of these principles it is hoped, will result in the establishment of a student lounge in the basement of Sibley in the near future. Also, an opinion poll of the various courses which will include instructors will again be conducted. The requirements have been changed because of the new curriculum but the upper quarter of a class is eligible after the completion of four terms; and after five terms, the upper half is eligible. The present officers of the society are Fredrick Turk, president; James J. Jackson, vice-president- treasurer; and William Sommers, secretary.

Engineering Societies

Pi Tau Sigma

Pi Tau Sigma gives recognition to mechanical engineers who have shown their ability by a high scholastic record and participation in extra-curricular activities. Faculty-student cooperation is also fostered. Second term Juniors who are in the upper quarter of the class and Seniors in the upper half of their class are eligible for membership in the society founded this year at Cornell. The establishment of a Sibley Student Council is being planned to represent the Sibley School in the Student Council and in relations with the faculty.

The officers of the society are: Warren Higgins, president; Wallace K. Clarke, vice-president; Walter McCarthy, recording secretary; William Hansen, corresponding secretary; and George Halsey, treasurer.

American Society Of Mechanical Engineers

The principle objectives of the Student Branch of the A.S.M.E. are: 1) to broaden the students' acquaintance with the practical side of the practice of Mechanical Engineering, 2) to develop the students' initiative and ability to speak in public and to familiarize him with the parliamentary procedure and organization of learned societies, 3) to enable the student to establish fraternal contact with his fellow students in engineering, and to meet graduate engineers engaged in the active practice of mechanical engineering.

Any student registered as a regular student in mechanical engineering or majoring in mechanical engineering leading to a degree is eligible for student membership.

The officers of the Cornell Branch are Frank W. Kinsman, chairman; George D. Russell, vice-chairman; Bernard J. Cantor, program chairman; and Prof. H. H. Mabie, honorary chairman. Prominent engineers will speak at future meetings of the society, and field trips are also planned.

American Institute Of Electrical Engineers

The Cornell branch of the A.I.E.E. presents topics of interest to electrical engineers and gives members of the student body the opportunity to participate in activities which are not included in the engineering curriculum. About a dozen meetings are planned for the year, one of which will include a visit to the Nuclear Physics Laboratory. A student paper contest to be presented orally is also being planned; the winners will represent Cornell at the annual district convention to be held at the University of Vermont. All students are invited to participate in the society, whose slate of officers is: Norman McIver, chairman; Robert Watson, vice-chairman; Howard Lemelson, secretary; Robert Whitman, treasurer; and Professor McIlroy, advisor.

American Institute Of Chemical Engineers

The American Institute of Chemical Engineering was founded for the purpose of correlating and disseminating information on topics related to Chemical Engineering. The Cornell Chapter was founded in 1937. The society has monthly meetings, part of which time is devoted to a lecture by an authority on some phase of chemical engin-

(*Continued on page* 48)

The Editor's COLUMN

Cornell Society of Engineers

What is the Cornell Society of Engineers? Many of our undergraduate readers have noticed the page devoted to the society in each issue of the CORNELL ENGINEER, and asked just such a question. In an attempt to answer them, it may be said that the society is an organization of Cornell engineers with membership open to every person who has been enrolled in the College of Engineering at Cornell. Its objects are, "to promote the welfare of the College of Engineering at Cornell University, its graduates, and former students and to establish a closer relationship between the college and the alumni."

At present, the active membership is approximately 2700, with the greatest strength in the eastern United States; however, under the leadership of Mr. Creed W. Fulton, the current president of the society, an expansion program is under way with a goal of 1500 new members this year and the forming of new chapters in several mid-western cities.

The future members of the society are now the engineering students at Cornell and it is with them that the ultimate future of the society rests. For that reason Mr. Fulton is especially interested in obtaining the support and interest of the graduating seniors in society affairs.

The society offers its members a chance to meet with other Cornell engineers at regular meetings for which outstanding speakers are obtained. A committee on "advisers to graduates" has been set up which should prove valuable to all society members with professional problems. In addition, eight issues of the CORNELL ENGINEER are included in the annual membership fee of three dollars.

In the near future all graduating seniors will be given a chance to join the society. It is hoped that they will give earnest consideration to the benefits of belonging to such an organization.

Cornell Society of Engineers

107 EAST 48TH STREET — 1948-1949 — NEW YORK 17, N. Y.

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WILLIAM LITTLEWOOD, *Executive Vice-President* 166 Brompton Road, Garden City, N. Y.

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GEORGE C. NORMAN, *Vice-President* ....27 Washington St., Newark 2, N. J.

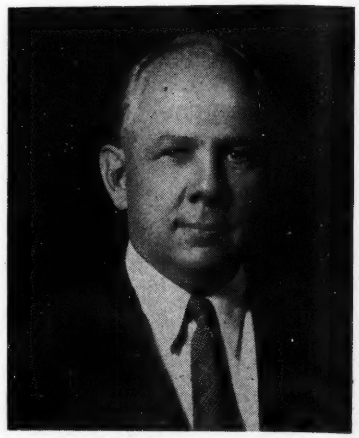
GEORGE C. BRAINARD, *Vice-President* ....1200 Babbitt Road, Cleveland, Ohio

LINTON HART, *Vice-President* ....418 New Center Bldg., Detroit 2, Mich.

Honorary President: S. C. Hollister, Dean of the College of Engineering

Honorary Vice-Presidents:

C. R. Burrows, Director of the School of Electrical Engineering
N. A. Christensen, Director of the School of Civil Engineering
W. J. King, Director of the Sibley School of Mechanical Engineering
F. H. Rhodes, Director of the School of Chemical and Metallurgical Engineering
W. R. Sears, Director of the Graduate School of Aeronautical Engineering
L. P. Smith, Director of the Department of Engineering Physics



Creed W. Fulton, M.E. '09

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University its graduates and former students and to establish a closer relationship between the college and the alumni."

New Horizons

The week end of October 23rd was an eventful one. For the first time, to my knowledge, a group of men representing the Cornell Society of Engineers sat down with the Dean and the directors of the various schools in the College of Engineering, and the editors of the CORNELL ENGINEER, to discuss ways and means of achieving our major objectives.

Primary aims are to further enhance Cornell's reputation in Engineering, and to create a greater acceptance of Cornell engineers over a constantly widening area. Both are good now, but we aim to make them better. Pre-eminence in both respects is the goal.

Every Cornell engineer has a stake in this program.

Cornell's reputation is a great asset to them in a strictly business sense. In addition it should be a source of great pride.

Cornell engineers have achieved outstanding success in many fields. Their performance, plus Cornell's reputation, are the priceless ingredients which create ready acceptance of Cornell engineers on a wide front. Your Society is out to make itself an effective and valuable agency for building up in every possible way this reputation and acceptance.

We need to tell better the story of the great job Cornell is doing, and planning to do, and the story of achievement by Cornell engineers in many fields.

We want to develop closer contacts with the undergraduate engineers, and to interpret to them events in the industrial world which they ultimately will join. To this end an undergraduate chapter of the Society is under consideration.

We want to help the graduating engineers find a place in the scheme of things, promptly after graduation, and to provide stimulating and helpful programs through our regional sections which will assist in adjusting them to their industrial environment.

To this end we need to increase the number of regional sections so that we will have well organized local chapters in all centers, where justfiied by numbers and interest. Through our local chapter meetings, we plan to bring Cornell engineers face to face with the outstanding accomplishments of Cornell in engineering, and of Cornell engineers in industry.

We have a real job to do, which is in the interest of the University and of its engineering alumni. It ought to be done well.

In future messages, I shall try to tell you more about what we plan to do, why, and how. But right now, I want to ask you to do something to help this cause along. It is very simple, but it is very important to our success. We need a substantial increase in membership to sustain this new program. *If you are not already a member, will you become one right now?* All you need do is to send your name and address, together with your check for $3.00 to Paul Reyneau, Secy.-Treasurer, at 107 E. 48th Street, New York, 17, New York.

And then we want you to do one thing more—please secure for us at least one new member, from among your Cornell engineer friends.

If each of you will do this we will double our membership, expand our influence, and increase our effectiveness.

That will be your contribution to helping us create new horizons for yourself, and for future Cornell engineers.

CREED W. FULTON

News of the College

Organizes Yale Symposium

Dr. Burrows, head of the School of Electrical Engineering, is presently organizing a symposium on Microwave Astronomy, to be presented at the Yale meeting of the American Astronomical Society this month. Dr. Burrows is well qualified for the job having worked in conjunction with Mr. W. E. Gordon on the Cornell Microwave project.

M.E. Faculty Appointments

The Sibley College of Mechanical Engineering has announced the appointment of a number of new faculty members, having outstanding records in their respective fields of engineering.

One of the outstanding appointments, is Professor E. K. Hendriksen, head of the Materials Processing Dept. Prof. Hendriksen comes to Sibley College with a distinguished background of achievement, particularly in the field of machine tools research.

During the years of 1932 to 1941, he was an Associate Professor of Mechanical Engineering at the Royal Danish Technical University, where he instructed in machine tools and production methods. In 1941 Professor Hendriksen was appointed to a full Professorship, and was put in charge of the machine tools research laboratory. His affiliations include the Danish Institute of Engineers and the Danish Academy of Engineering Science. He has done much traveling in the roll of a consultant, in Belgium, England, and Germany. Professor Hendriksen's research papers include significant studies in the field of residual and internal stresses on machined surfaces.

Another appointment of note, is that of Professor D. G. Shepherd, Assistant Professor of Heat Power Engineering. Professor Shepherd has had extensive experience with power jets, and is a member of Tau Beta Pi.

Other new appointments include, Assistant Professor Fred Saltz, Machine Design Department; and Professor White, in charge of non-resident lectures.

Pipeline-Network Analyzer

The College of Engineering has authorized construction of a pipeline-network analyzer, under the supervision of Professor M. S. McIlroy. of the School of Electrical Engineering.

This pioneering venture in the field of analyzing flows and friction losses in complex networks of pipelines, by means of electrical devices arranged to be analogous to pipeline system components will be constructed to represent ultimately one-hundred and twenty seven elements in a hydraulic circuit, but will initially contain only sixty-seven elements.

The individual pipelines will be represented by specially designed electrical resistors, having nonlinear characteristics analogous to the relation between headloss and flow in pipelines.

Professor McIlroy pointed out that there are practically no limitations on the size of future units serving similar purposes for larger, and more complex pipeline systems. He further stated that the analyzer will be particularly useful to engineers in the waterworks and gas distribution fields where complex networks of pipelines are used.

Considerable aid is being given to the project by the Standard Electric Time Company of Springfield, Massachusetts who will make the standard components. It is expected that the device will permit rapid studies of alternate methods of construction of rearranging the pipeline systems, and will assure the designer that the method selected will be the most desirable and economical one.

The major financial support for this project is being provided by the College of Engineering.

HONORARIES AND SOCIETIES

ASME

Mr. Harold Kneen, Cornell ME '25, Vice President in charge of production at the Lincoln Electric Co., spoke to the members of the Cornell Student Branch of the American Society of Mechanical Engineers, Thursday evening October 21, 1948, and discussed "Mr. Lincoln's Incentive System."

Mr. Kneen devoted half the program to an explanation of the employee incentive system used by the Lincoln Electric Company, going into its origin in the early thirties, the depression period. He illustrated his talk with several specific cases of employees who reacted very favorably to the Lincoln System. The latter portion of the period was devoted to questions from the floor, which were answered by Mr. Kneen.

Tau Beta Pi

The Tau Beta Pi honorary engineering society conducted a series of four lectures in Olin Hall last month on the use of the slide rule. This free instruction was particularly valuable to incoming engineering freshmen, and it is contemplated that the extensive use made of these lectures will encourage future similar series.

ASCE

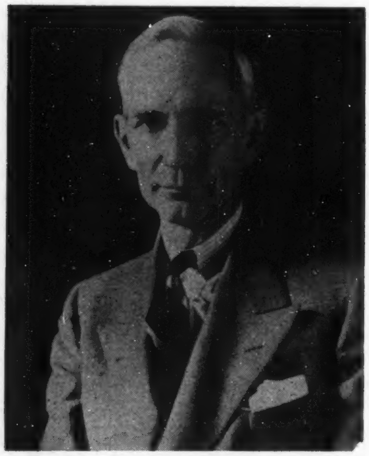
On October thirtieth, the student branch of the American Society of Civil Engineers made what proved to be a very interesting inspection trip, to the Onondaga flood protection project. The construction is contracted for by the City of Syracuse, and is located ten miles from the city.

Professor Donley arranged and conducted the trip, and was received by Lt. Col. C. W. Reilly, in charge of the project for the Corps of Engineers.

(Continued on page 32)

Alumni News

Charles D. Young, M.E. '02, retired president and director of the Pennsylvania Railroad, is the 1948 recipient of the Henderson Medal of the Franklin Institute of the State



Charles D. Young

of Pennsylvania. The medal, which was awarded October 20 at the traditional Medal Day ceremonies at the Institute, goes to Mr. Young for his "contribution to the scientific advancement of the steam locomotive which has resulted in improving the reliability and efficiency and reducing the cost of steam locomotives, thereby producing a more effective transportation unit."

George William Lewis, M.E. '08, M.M.E. '10, Sc.D., was respectfully honored on Sept. 28 when the Flight Propulsion Research Laboratory at Cleveland, Ohio was renamed the Lewis Flight Propulsion Laboratory. This laboratory was conceived by Dr. Lewis in 1939 and authorized by Congress in 1940. Dr. Lewis, a graduate instructor in engineering at Cornell and a Professor of Engineering at Swarthmore College from 1910 to 1917, was a leader in the field of aeronautical engineering for many years. He was director of the National Advisory Committee for Aeronautics from 1919 to 1947. He designed the first Roots type supercharger for aircraft engines, developed many of the wind-tunnels in this country, and, as director of this committee, aided in the developments which gave this country air supremacy during the war. In 1947, he retired as director and became Research Consultant for the N.A.C.A. He received numerous awards during his career including the Presidential Medal for Merit, and he represented the United States at international aviation conferences.

Leroy R. Grumman, M.E. '16, chairman of the board of the Grumman Aircraft Engineering Corp. of Bethpage, Long Island, was featured in "Look Applauds" in the August issue of LOOK magazine. In "'Look Applauds," recognition is given to outstanding personages who have made distinguished contributions to knowledge, culture, and the improvement of human relations. Mr. Grumman, the maker of the Navy's famous wartime Hellcats, was awarded the 1948 Daniel Guggenheim Medal for achievement in aviation.

Memorial plaque naming the Flight Propulsion Laboratory for George W. Lewis, '08, '10, director of the National Advisory Committee for Aeronautics for 28 years.

Edward S. Corcoran, M.E. '17, is the president of the Baltimore Motor Car Company, vice-president of The Chronicle Publishing Company, and the owner and developer of Beacon Hill housing project on Chesapeake Bay.

V. A. Tan, C.E. '18, who is Dean of the College of Engineering at the University of The Phillipines, Manila, dropped in at Cornell this fall. He was visiting universities in the U. S. to gain ideas to be used in the rebuilding of the College of Engineering which was largely destroyed by U. S. bombs in driving the Japanese from the islands.

William L. Everitt, E.E. '20, was appointed dean of the college of engineering of the University of Illinois at Urbana. Head of the department of electrical engineering at Illinois since 1944, he will also take over the directorship of the University's experimental station. Professor Everitt was an instructor at Cornell from 1920-22, instructor and the assistant professor at the University of Michigan from 1922-26, and associate professor and then later professor at Ohio State University from 1926 until he joined the Illinois faculty.

Aslag H. Eskesen, A.B. '23, has been elected president of General Electric's Argentina, South America, Company which is affiliated with the International General Electric Company. Mr. Eskesen originally joined General Electric in 1932 when he entered the business training at Edison Lamp Works at Harrison, N. J. In 1926, he joined the general auditing staff in Schenectady, remaining there ten years. Then Mr. Eskesen held a position with Rex Cole, Inc., and later with General Electric Contracts Corp., in New York City, where he was assistant to the president. His first

(Continued on page 35)

Book Review

THE ELECTRON MICROSCOPE, *Its Development, Present Performance and Future Possibilities. By D. Gabor.* 157 *pp. Chemical Publishing Company,* $4.75.

It is not quite clear for whom this brief report on the electron microscope is intended, for there is much in it that will appeal to readers only contemplating the use of such a microscope as well as to those who are specialists in the field of both use and design of electron microscopes. The monograph is an enlarged and broadened version of a lecture given during the war by the author, a leading worker for a long time in electron optics, to the Cambridge University Physics Society. It is intended to serve both as an introduction to the instrument, as well as to make several critical contributions to its theory. As such, the first portion of the book will appeal primarily to the many non-electronic researchers in various fields, in acquainting them with the underlying basis of the microscope and to acquaint them somewhat with various specific instruments and their possible uses. The latter portion of the book, however, will certainly appeal more to physicists and engineers already familiar with the instrument.

Following a very brief historical introduction, there is a discussion on geometrical electron optics with the usual analogy between Hamilton's principle in mechanics and Fermat's principle in ordinary optics. The explanation of the electrostatic lens is concise and qualitative. That for the magnetic lens is analytical and may leave readers somewhat bewildered as to the actual action of the magnetic lens on the electrons passing through it. Aberrations are qualitatively discussed and the crudity of electron optical systems in terms of ordinary optical standards, with the importance of the effective millionfold increase in illumination available with electron optics, is adequately stressed. The importance of the wave concept of electrons is taken up briefly following the geometrical picture. These two chapters form the basis for practically all that follows in the book.

After presenting the fundamental principles, instruments are discussed with a brief mention of the simple projection microscopes, useful in studying electron emission from surfaces, and a general look at the now more familiar transmission electron microscope, unfortunately sometimes referred to as the supermicroscope. Both electrostatic and magnetic lens systems are covered, with the extreme importance of voltage stabilization in the driving circuits of the latter type of instrument brought out.

Origin of Contrast

An interesting chapter to many readers will be that on the origin of contrast in the electron microscope. In ordinary optical microscopy the contrast arises primarily from light absorption. In the case of electron microscopy the contrast arises not so much from absorption of the illuminating electrons as from scattering by the object, together with the lens defects that are still inherent in electron optical lens systems. How this comes about, together with the importance of diffraction and phase changes in producing contrast, are well discussed on a qualitative basis.

At the present time the best resolution (essentially the smallest separation observable between particles) achieved with the electron microscope is around 10°A while the detection limit (essentially the smallest sized particle observable in bright field illumination), involving as it does contrast, is also about the same order of magnitude. Two chapters of the book are devoted to the analysis of these two limits.

In the next three chapters several commercially available microscopes are described and their achievements discussed. Included is a brief discussion of the scanning electron microscope used somewhat in the examination of the surfaces of thick metal samples.

The latter portion of the book, of not so general interest, is devoted to the possibilities of future development in the art. It is primarily a discussion of means possible for correcting electron optical objectives. Mention is made of a suggestion by Kompfner, father of the traveling wave amplifier, for correcting objectives with the use of high frequency potentials rather than the now used static potentials.

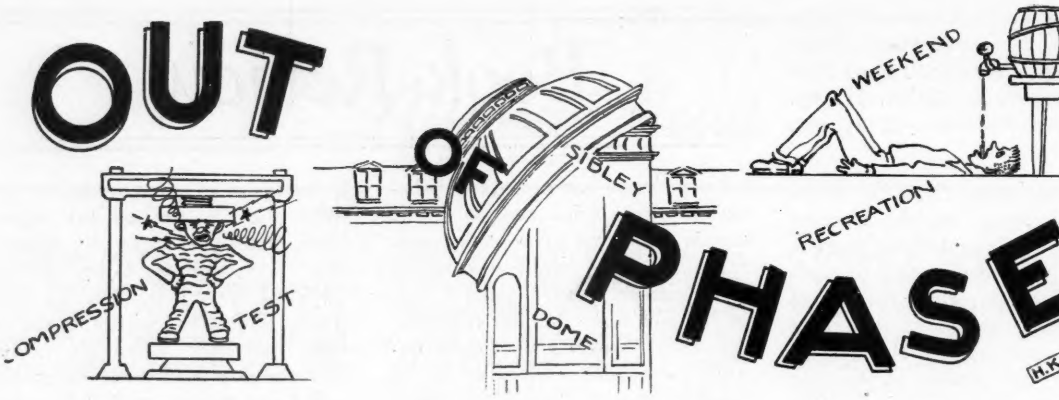
But the greater part of this discussion is taken up with an analysis of the author's own suggested space charge corrected objective. He has made the suggestion that the imaging electrons be fired through a region of specially shaped space charge density, the space charge arising from other electrons circulating in the region in the manner of the ordinary static magnetron. It might be fairly said that the author unduly labors this analysis in a book of this sort but it will undoubtedly be of interest to physicists and engineers. Mention is also made of a microscope being developed in Paris under de Broglie's guidance which makes use of high velocity protons rather than electrons, to take advantage of the resolution theoretically possible with the much shorter wavelength associated with such an imaging particle.

Limit of Election Microscopy

The book is concluded with a discussion of the ultimate limit of electron microscopy, given perfect objectives utilizing extremely short wavelength particles; a brief discussion of chemical and structural analysis wtih the electron microscope; and an appendix on the diffraction theory of microscopy. There is a fairly good bibliography, by no means intended to be complete, at the end of the book.

All in all, most of the important features of the microscope, types of instruments and tcehniques are mentioned, however briefly. The discussions are for the most part qualitative so that the book may find w.de acceptance among those desiring an acquaintance with this important research tool.

P. L. Hartman
Assoc. Professor of Physics



By HERBERT F. SPIRER, EP '51

Memories:

How I long for the good old days of the Freshman Chemistry Lab. There was a lab in which you couldn't go wrong. *You* couldn't, but I usually could. It cost me five bucks to buy enough glass to make those two right-angle bends required to complete the first experiment. I had my revenge, though. I burnt my right hand so badly that I didn't have to come to the lab for six weeks.

And those lab reports! What works of art. What masterpieces. It wasn't bad enough that the same lab notebook had been used for the past twenty-eight years and that every fraternity has four hundred completed copies. The way I remember it the instruction sheet went something like this . . .

Exp. 492: DEHYDRATION OF TRI-METHYL QUI-AQUILOHEPTIPAPITOL.

Object of the Exp.:

In this experiment you will dehydrate tri-methyl quiaquiloheptipapitol. This substance is of importance because once in the autumn of 1418 an alchemist named Bernedada Sitzfliesch found that houseflies became drunk after sniffing the fumes from a beaker of this substance. Although that was the last time that this substance was of practical value, the techniques you will use today should be in the repertoire of every student of chemistry. The ability to handle tools, instruments, and glassware that became obsolete in 1524 will be excellent training for your little minds and clumsy hands. Working against the same obstacles that the earlier alchemists worked against will give you some idea of the sound scientific basis of experimental chemistry.

Equipment Required:

One hot-water bottle, two beer bottles (empty and washed clean), one whisk broom, two watch-glasses—buy these from the stockroom at $3.50 apiece. As these will be completely destroyed during the experiment no student will be allowed to use the cheaper variety of watch-glass. Also necessary will be one ring stand, two houseflies, three gallons of cider, one gold brick, eighty-five pencils, six slide rules, twenty-five right angle bends, which should be left over from your last experiment, but if they were destroyed during the final explosion of the last experiment, you will have to buy another two hundred feet of glass tubing and bend it on your own time.

Warning:

You are working in a chemistry laboratory. There are dangerous acids and fumes laying about on tables. Do not put any university property near these corrosive substances. Remember, if you should burn off your left arm with sulfuric acid you will not be punished. If you drop the matches which were issued to you at the beginning of the term into the acid, you will be expelled immediately. Students are also requested not to squirt any hydrochloric acid into the eyes of other students. We have had considerable trouble acquiring our share of this expensive acid and do not wish any more inconvenience. We have more important things to do than supply equipment for students to experiment with.

Procedure:

Fill a two gallon beaker with the amber colored liquid you will find in two ounce bottles at the shelf along the window. Please be efficient and fast as there are four hundred other students doing the same experiment.

Now return to your bench. Pour the contents of the two gallon beaker into sixty-four two ounce Erlenmeyer flasks. As you were issued only two of these small flasks at the beginning of the term you may find it necessary to purchase a few more from the stockroom. Do not be shy about making purchases from the stockroom. It is here for your benefit . . . to protect you from the mercenary tendencies of the local merchants, who have never been above taking advantage of young students.

Wipe off the bench. These benches are very delicate, highly machined surfaces. In order to protect the excellent finish you should wipe off the surface of the bench with only the finest lens tissue. The stock-

(*Continued on page* 26)

High Voltage Transmission

(*Continued from page* 10)

When we do this we may observe some phenomena which would certainly not be part of a practical 500,000 volt line, but they will be of extreme interest and profit in determining the practicable limits. As a matter of fact, what these limits are is not known at the present time, and they will be influenced to a considerable extent by the results of these tests.

"We are planning to run these tests continuously for approximately three years and so obtain not only the benefit of indicated observation, but the benefit of integrated observation over a considerable period of time; this will make it possible to determine the effects of seasonal and weather variations.

"In closing, I think it might be pertinent to call attention to the fact that this entire project is an outstanding example of cooperation between a group of segments of private enterprise. There does not seem to be any question that both technologically and economically the development of electric power, and the art of electric power generation, transmission and distribution, has gone farther in the United States than anywhere else on the face of the civilized globe, and it has done so largely under a system of private enterprise. Both, the power systems themselves, and the manufacturing groups that build and supply the equipment, belong in that category.

"We hear a great deal these days about the private enterprise system having to prove itself in order to meet the challenge of collectivism. The recent war gave a demonstration on a universal scale that people operating under a democracy could out-think, out-plan, out-build, out-produce and out-fight those operating under a totalitarian impediment. On a much smaller scale, we see here that in a particular field of technology the private enterprise system can likewise outdo these operating on a collective basis."

Out of Phase

(*Continued from page* 24)

room has ordered a stock of these lens wipers as an added convenience to you.

Take a piece of litmus paper one quarter inch wide and one inch long. Cut this into sixty-four parts. If you have any difficulty with this step, the lab instructor will be glad to show you the proper technique. Do not be afraid to ask the instructor any questions that should arise, if you can find him.

Drop a piece of litmus paper into each of the two ounce flasks. It will be necessary to keep each piece of litmus paper floating on the top of the liquid. This may call for very refined techniques, as the liquid is much less dense than the litmus paper, and the litmus paper you will get will already have been used by the advanced classes.

Should any of the jars of amber liquid now begin to turn pink you have allowed impurities to get into the liquid and must begin the

(*Continued on page* 28)

Out of Phase

(*Continued from page* 26)

process all over again, starting from the first step.

Note:

Impurities will get into the liquid under any of the following circumstances:

1. If the flasks into which it has been poured are not brand new. Flasks may, as we have mentioned before, but feel obliged to repeat, be purchased from the stockroom.
2. If any air containing hydrogen sulfide (to the extent of one part of seventy-two million) contacts the surface of the liquid.
3. If you sneeze near the flasks.
4. If you drop litmus paper into the liquid.

Procedure, Continued:

Now proceed to the shelf at the far end of the room, where you will find sixty-four bottles numbered from one to sixty-four (inclusive). These bottles contain unknown substances which you will identify in next week's experiment. Take a sample from each bottle of unknown with an eyedropper or pipette. A separate pipette or eye dropper will be required for each unknown. Fortunately the stockroom has been able to build up a large supply of these devices.

Put a drop from each eye-dropper or pipette into a corresponding flask containing the amber liquid and litmus paper. Caution: The litmus paper *must* be floating on top of the liquid surface. The amber liquid *must* be amber. You must not breath throughout the rest of the procedure. Remember that you are not being marked on what you do, but on how well you do it. Of course, if you use the correct procedure and don't get the correct results, you will be penalized.

Now, simultaneously stir all sixty-four flasks. Should no reaction occur, shake all flasks violently at the same time. Do not spill any liquid. See your instructor for details on how to perform this delicate operation. If you cannot find the instructor after a reasonable search, do the best you can, but don't expect us to help you if the spilt liquid burns the soles off your shoes.

You are now ready to answer the questions. A pen or pencil will prove to be invaluable in writing down the answers to these questions. After you have finished the questions, sweep up the broken glass and destroy all equipment you used so that you can get off to a clean start next week. There is a full supply of new equipment in the stockroom. Please make all checks payable to the University.

Questions:

1. What did you do today?
2. How?
3. Why did you cut the litmus paper into sixty-four pieces?
4. How many atoms in a molecule?
5. What color was the precipitate in bottle number 34?
6. Why was the precipitate in bottle number 34 green?
7. How high is up?
8. Define: good, bad. Right, wrong. Chemistry, physics.

(*Concluded on page* 30)

Faculty Introduction
Prof. Underwood

(*Continued from page* 17)

Professor Underwood is probably most widely identified with the Summer Survey Camp, a five week practice period at Cayuga Lake for student civil engineers. He began instructing in this course in 1908 and has been in charge of the camp since 1917. During the past forty years he has maintained the remarkable record of having missed only one session of the camp.

From 1912 to 1922 he was Assistant Professor of Topographical and Geodetic Surveying at Cornell. Since 1920 he has been in charge of the Department of Surveying, and in 1922 he attained his present position of Professor of Surveying. Professor Underwood served as Acting Director of the School of Civil Engineering from October 1937 to July 1938.

A field of special interest to Professor Underwood is the theoretical problems encountered in photographic surveying. He has written several articles and at present he teaches an elective course in the subject. Reading is his main diversion, and he is mildly interested in photography and coin collecting as hobbies.

Professor Underwood is well satisfied with a career of teaching engineering, pointing out that it offers both more security and more free time than industrial work. After more than forty years of service in molding the minds and characters of Cornell engineers, he can well regard his work with gratification.

Out of Phase

(*Continued from page* 28)

Liquid. Solid. Gas. Critical entropy.

9. Prove: The mixed partials are equal. Amber liquid is colored amber. A=B. Water flows. Oil seeks its own level.
10. Did you get foam from flask number 2?
11. Why did flask number 2 foam over?
12. Why should you always pour water into sulfuric acid?
13. What is sulfuric acid?
14. Describe 300 commercial processes for producing the unknown amber substance.

You have now finished experiment number 492.

Rest in peace.

Faculty Introduction

Prof. Winding

(*Continued from page* 17)

tend as an undergraduate. From this time on his career at Cornell was to be uninterrupted, and in the succeeding nine years he rose from instructor to Professor of Chemical Engineering. In 1947, when the school was redesignated the School of Chemical and Metallurgical Engineering, he became Assistant Director, a capacity in which even entering students quickly get to know him as their faculty adviser.

But teaching has been only a part of his eventful career. Frequent publications in technical magazines on such projects as heat transfer, fluid flow, the action of light on cellulose, and, most recently, polymerization, have high-lighted his work. He has also written "Plastics, Theory and Practice," McGraw-Hill (1947), with R. L. Hasche, a book which is *not*—and this is worthy of note—a required text in the materials course which it anticipates. As a consultant for Tide Water Associated Oil Company, he has had ten patents on synthetic adsorbents for the treatment of lubricating oils. During the war he directed one of the government-sponsored research projects at Cornell on synthetic rubber, and he is currently engaged in writing the plastics and rubber section for a forthcoming materials handbook. As a licensed professional engineer in the State of New York he has been frequently consulted by industry on his main interests: petroleum, plastics, heat transfer, and fluid flow.

Perhaps it is not surprising that Minnesota, land of many lakes, should have produced a sailing enthusiast. Brought up by the famed waters of Minnetonka, Professor Winding has not only followed yachting as a hobby since boyhood, but he is now commodore of the Ithaca Yacht Club and a captain in the U. S. Coast Guard Auxiliary. Fair weather on Cayuga—elusive though it may be—will often find him tracing an intricate wake in his International "110", a "bus driver's holiday" from fluid flow problems.

College News

(*Continued from page* 21)

Pi Tau Sigma

Director King of the School of Mechanical Engineering has announced the formation of the newest chapter of Pi Tau Sigma, the national honorary mechanical engineering society, here at Cornell. It is expected that the charter will be granted this winter, and will be presented at a formal installation of charter members. Warren Higgins is the present president of the organization.

Dr. King expressed his pleasure in making this announcement, and is presently working on the formation of a student council for the College of Mechanical Engineering, to consist of joint representatives of the student body, Pi Tau Sigma, Atmos, and Kappa Tau Chi.

AIEE

At a recent meeting of the student branch of the American Institute of Electrical Engineers, it was decided by the members to take

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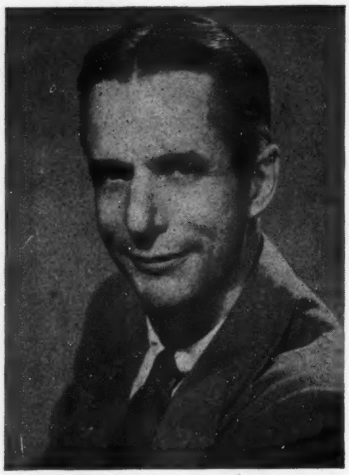
Alumni News

(*Continued from page* 22)

foreign work was in Brazil, where for three years he was vice-president of Financiadora Commercial, S.A., a subsidiary of G.E.S.A. Brazil. In 1940 he took a leave of absence to work for the British Purchasing Commission in New York City, and in 1941 he was named comptroller and last year vice-president and General Manager of G.E.S.A. Argentina.

Lewis R. Gaty, E.E. '23, '24, was named as manager of the engineering department of the Philadelphia Electric Co. with which he has been associated for a number of years. Mr. Gaty is a member of the American Institute of Electrical Engineers, the Engineers Club of Philadelphia, and the Cornell Society of Engineers. He is president of the company's employees' association.

Leo K. Fox, M.E. '25, has been on the staff of the National Electrical Manufacturers as secretary for the appliance section.



Lewis R. Gaty

Fu C. Kuan, C.E. '30, M.C.E. '31, is technical advisor to the Huai River Bureau, a Chinese Government water conservation board. Professor of hydraulic engineering of the Central University of Nanking and chief engineer of the waterways of the Kiangsu Province before the war, Kuan served during the war as sub-manager of the Farmers Bank of China, Hongkong Branch, doing purchasing of strategic material for the Chinese Government. He is a member of the American Society of Civil Engineers and the American Society of Mechanical Engineers.

James P. Tatersfield, M.E. '30 is still with Babcock and Wilcox de Mexico, South America, and new has charge of all the Carribean area besides Mexico.

Alan E. Coddington, C.E. '27, who is chief engineer for Carey, Baxter & Kennedy, Inc. contractors in New York City, presented a paper, "Developments in Haulage of Overburden in Anthracite Strip-mining" at the American Mining Congress convention in Cincinnati, Ohio last spring. He is currently operating one of the largest strip mines in the anthracite region near Tamaqua, Pa.

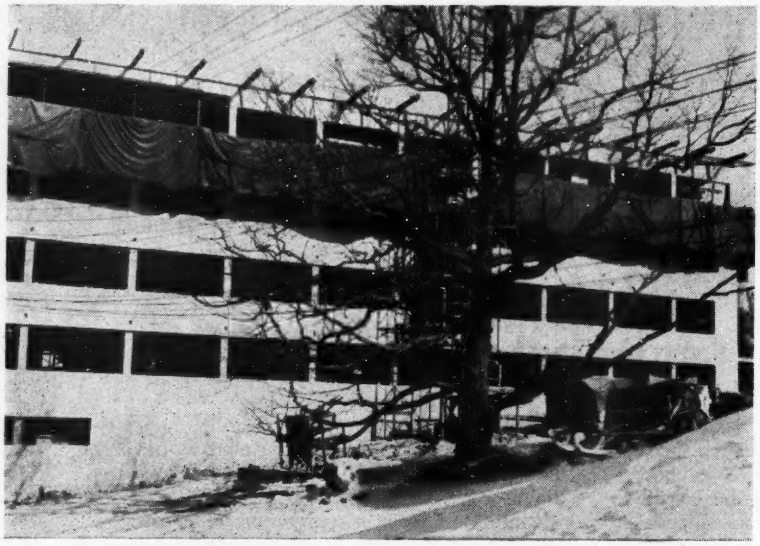
(*Concluded on page* 46)

Cornell's Synchrotron

(*Continued from page 13*)

floor. The room is somewhat surprising, since the north and south walls each consist of one sheet of glass. The door, rather than being an opening in the wall, is an obstructon to vision.

In the corridors, which smell of fresh paint, we walk past offices and laboratories to the automatic elevator, which obediently takes us to the third floor, where we pay a visit to Prof. Robert R. Wilson, the director of the laboratory. His office, like all the others, has plate-glass windows almost ceiling high, and we find the women's dormitories, the Ithaca golf course, and the Kline Road temporaries spread out before us. We have a short but interesting conference with Dr. Wilson, who explains that the topic of investigation in the laboratory will not be nuclear physics in the strict sense, but a somewhat different and as yet unnamed field. Nuclear physics deals with the arrangement of subatomic particles in atomic nuclei, while the new studies will be directed toward the subatomic particles themselves, to learn more about their properties, since they do not obey the classical laws of electrostatics when very close to one another. He tells us that the object of the synchrotron, the machine around which the laboratory is figuratively built, is to provide particles of such energy that on collision they will produce radiation of extremely short wavelength, about the diameter of an electron. Somewhat as an electron microscope, with its high-frequency (compared to lights) shortwave length radiaton enables us to see smaller things than a light microscope, the radiation of tremendously high frequency obtained from the operation of the synchrotron will enable the staff of the laboratory to make previously impossible measurements on the smallest of all particles.



Curing the concrete under winter conditions was one of the engineering problems encountered in the construction of the Nuclear Physics Laboratory.

Roof Promenade Provides View

To complete our tour of the laboratory, we walk up one more floor and on to the roof promenade, which runs the full length of the building and affords an even better view than the third floor offices. It is a clear day, and we can look far up Cayuga Lake and see a large area north and east of the University. Several stories below us, oriented at an angle and some 30 feet from the laboratory, is the square synchrotron building, built almost underground except for the northeast side, which consists largely of windows.

This reminds us that the technically interesting portion of the trip is still ahead of us, and we go immediately to the sub-basement, which is on the same level as the floor of the synchrotron building. Here we are shown the large generator room and some of the laboratory rooms in which development work is being done on various parts of the machine. We begin to feel from the air of activity about the place that we are near the heart of the project.

Control Room

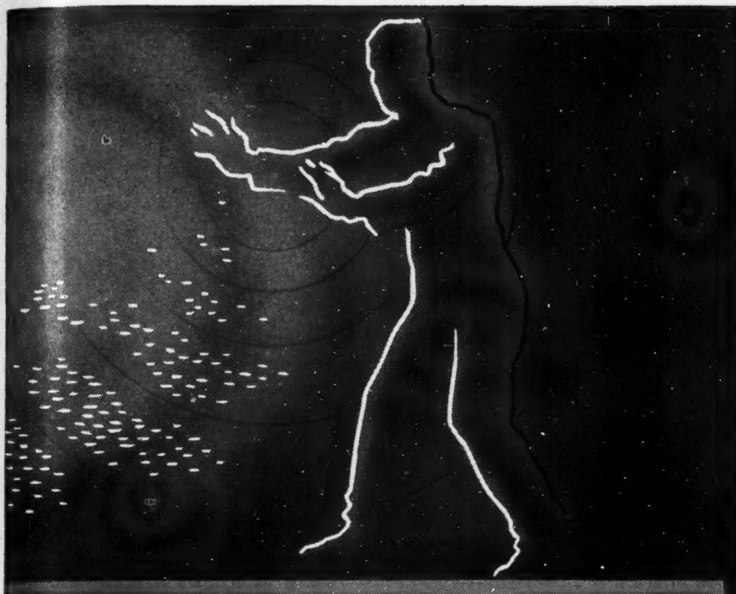
Last stop in the sub-basement turns out to be a very interestng one—the control room for the synchrotron. It contains a very neat and impressive bank of instruments and switches, in front of which are a swivel chair and a microphone. The physicists here are obviously not the kind who can be accused of doing slipshod practical work in their preoccupaton with theory—the panel looks quite professional. Our guide points to the two meters which will measure the current and voltage supplied to the synchrotron magnets—an ammeter which can read 2500 amperes full scale and a voltmeter calibrated in kilovolts.

Synchrotron Room

The size of the synchrotron has been increasing in everyone's imaginaton, so that as we walk through the tunnel to the accelerator building some begin to wonder if they will have room to get into the building to see it. When we walk out of the other end of the tunnel into the main room of the accelerator building, we find that the machine takes a relatively small portion of the space, but that it is impressive enough in itself. The 24 big C-shaped magnets sit in a circle thirteen feet in diameter with the arms of the C's facing the center. The magnets themselves are five feet high and are built up of laminations to a foot in thickness. We are allowed to climb up on top of the machine, where we can see the pole pieces, flux bars, and the glint of the pyrex "doughnut"—the circular accelerating chamber—buried behind the masses of iron built around it. A low, rhythmic exhaust noise issues from the mechanical vacuum pump that provides low back pressure for the diffusion pump whch maintains the vacuum in the "doughnut."

As we climb down from the ma-

(*Concluded on page 38*)



Cornell's Synchrotron

(Continued from page 36)

chine our field of interest widens, and we begin to look around the room. The synchrotron stands near the southwest wall, opposite from the wall which contains the windows. It is fitted with several large ventilating pipes, to carry off the heat generated by the 300 kilowatts of power the machine will use in operation. Other auxiliary apparatus in the room are a very large variable inductance, an injector which will introduce electrons into the machine at 70,000 electron volts energy, and several large direct-current magnets to provide constant fields for certain experiments. Mounted on rails on opposite walls near the ceiling is a five-ton-capacity traveling crane, whose usefulness we acknowledge when we are told that the synchrotron assembly weighs 85 tons.

After examining all the equipment in the room we have a lengthy talk with the physicist who has shown us the machine. He tells us that it is not yet ready for operation, since many measurements and adjustments must still be made. Even when work is started, the synchrotron wll not be able to run at full power, for the coordination of the various events in its cycle of operation is critical and difficult to achieve at the outset. The staff is quite confident, however, that it will, after a time, operate at full power and produce the 300 million volt electrons which will be the chiem interest of the laboratory. Although many uninformed people tend to be afraid of the machine, placing it in the same class as an atomic bomb, it is no more dangerous than X-ray equipment, and will produce a relatively small amount of radiation. The chief discomforts of being in the accelerator building while the machine is in operation would be noise and heat, since the heavy 60-cycle current and consequent rapidly changing magnetic fields will cause the magnets to vibrate. The small volume of radiation produced should be avoided, however.

Proceed With Equanimity

As we hear these physicists talk, we cannot help but admire their attitude toward their work. Proceeding into a project in fundamental science which may yield tremendously important information, with equipment which did not appear in their most optimistic dreams of a few years ago, they are yet calm, patient, and thorough. They are sure of what they know and acknowledge what they do not know. The experience of scientists before them has taught them not to make guesses on the basis of preconceived notions.

We leave the Laboratory of Nuclear Studies with inspiring impressions, for we have seen competent men and strange, wonderful machines organizing to seek out some of the innermost secrets of the universe.

PHOTO CREDITS:
Photos 1 and 5 by D. R. Corson; all others by Sol Goldberg.

Soils Testing Lab

(*Continued from page 8*)

dence that this practice may become increasingly popular.

In connection with the Government sponsored research, experiments are now being conducted to determine whether there is a correlation between the engineering behavior of soil and some of its more fundamental properties such as mineral composition, exchangeable ion saturation and specific surface. The correlation tests are being conducted by C.E. School staff members and a number of student assistants.

It is intended that the general purpose facilities mentioned above will include flumes for making seepage studies and for demonstrating piping and quicksand phenomena, as well as one large capacity testing machine of standard type for the conduct of special tests on soil which require unusual loading capacity.

Additional space in the new Laboratory is reserved for exhibits of various types including such items as equipment for sub-surface exploration and sampling in soil, photographs of earth moving operations, typical or unusual types of soil and other items of general interest. A small workshop is included in the plans and will be equipped and used in connection with the laboratory operation.

Curriculum Also Expanded

The above described expansion of laboratory facilities is concurrent with an expansion of the curriculum in Soils Engineering which will take effect at the beginning of the 1949-50 academic year. At that time two electives will be offered to seniors and graduate students in addition to the required undergraduate course. The electives will cover the theory and the practice of Soils Engineering respectively. In the latter course, there will be additional opportunity for use of the Laboratory by the students in working on practical problems. Both the new courses will devote more attention to fundamental properties of soils and of colloidal clay-water systems than has been possible heretofore.

Geiger Counter

(*Continued from page* 15)

counting the number of alpha particles produced by this reaction.

The Geiger counter had its introduction to pure science in 1908 by Hans Geiger, a German assistant of the British scientist, Lord Rutherford, who was then studying the radiations from radium. Geiger's first instrument was able to detect only alpha rays, but in 1914, he reported to the German Physical Society a device which could also count beta rays. By 1928, working with a German colleague, Müller, he perfected a counter which is essentially the same as the one in use today, still the most sensitive instrument available for the detection of radioactive particles.

Tool of the Practical Engineer

However, while the Geiger counters of about ten years ago were the instruments of the pure scientists working in the laboratory, today it is becoming more and more a tool of the practical engineer.

Geiger counters were first brought to the public's attention at about the time of the Bikini atom bomb tests, when reporters, noticing the target area spotted with the similar type instruments, began to ask what they were. They were told that these instruments were Geiger counters to be used to measure and record the radiation produced at different points in the area by the blast. They were also to be used after the explosion as "probers" to determine if an area was safe to enter. The crews inspecting the damage would carry counters with them to see if the amount of radiation present in the area they intended to inspect exceeded the safety limit. When the reporters were told of this instrument, they eagerly transmitted their information to their readers, telling them about this wonderful "new" instrument our scientists were using.

By that time, however, scientists had already made varied and valuable use of Geiger counters. Physicists had used it to analyze the particles emitted in their radiation experiments and in the study of cosmic rays. It had been employed by biologists to study life's processes through the method of following radioactive tracers. Use had been made of it by metallurgists in detecting minute radioactive impurities in metals.

These important uses are destined, however, to be totally eclipsed by the uses to which it will be put in the future age of atomic power, which, by its very nature, is a system built on radioactivity.

To Ascertain Radioactive Sources

It will be used by the prospectors of the future searching for the "atomic-age gold"—radioactive materials to furnish the energy for our coming power plants. By using the Geiger counter, men will not have to waste much time working useless sources, for by planting the counter in a certain area, the radioactive value of the land may be determined fairly accurately so that the searchers will know in what sections to start mining for their ore.

There will be a Geiger counter included as part of every device using or producing atomic energy, serving as an alarm against excess harmful radiation. For instance, if the atomic heater in your future home should encounter some mechanical difficulty and the radiation exceed some safety limit, the Geiger counter would be so actuated that it would shut off the system until the trouble was corrected. Chimneys of factories using atomic power will be equipped with counters so as to assure that the air of the city will not become overly contaminated with escaping radioactive particles.

In general, the Geiger counter is experiencing the same maturity that has come to many former instruments of the pure scientist. In the near future, it will become an even more important tool of the engineer and of industry. Finally, in a few short years, it will reach the peak of practical usage and will become as common a household item as the flashlight battery which, too, had its obscure beginnings in the experimental physicist's laboratory.

Alumni News

(*Continued from page* 34)

Harold Gassner, M.E. '27 is vice-president of the Rosedale Foundry and Machine Co. of Pittsburgh.

Wayne C. Edminster, M.M.E. '34, who supervised process design of the atomic pile (nuclear reactor) at the Brookhaven National Laboratory on Long Island, has been appointed a professor of chemical engineering at Carnegie Institute of Technology, Pittsburgh, Pa. At present he is senior chemical engineer and assistant director of process development for Hydrocarbon Research, Inc., of New York City and adjunct professor of chemical engineering at New York University. Lecturer and author of twenty-four publications in the hydrocarbon field, Edminster also taught at the Illinois Institute of Technology.

Byron E. Short, M.M.E. '36, Ph.D. '39, professor of mechanical engineering at the University of Texas, is serving as acting dean of engineering there for a period from April, 1948 to April, 1949.

Charles M. Carrier, M.E. '39, '44 Ph.D., was recently promoted to professor of engineering at Brown University, Providence, R. I. From Cornell, where he was a graduate instructor in Machine Design, he went to do research on the Pratt and Whitney project at Harvard University before joining the Brown faculty in 1946.

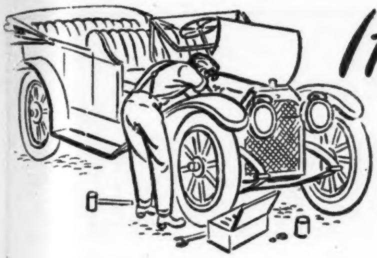
Victor E. Serrell, A.E. '41, is a field engineer for the Bakelite Corp. of Chicago, Illinois.

Deceased

Clark Dillenbeck, M.E. '88, retired chief engineer of the Reading Company, died in Plainfield, N. J. last October at the age of 82. Mr. Dillenbeck became widely known as a railroad bridge and pier builder. He retired from the railroad in July, 1938, after having been with Reading since 1890.

Ernest Rowland Hill, M.E. '93, president of Gibbs and Hill, Inc., a consulting engineering firm in New York City. From 1895, Mr. Hill was a special engineer for the Westinghouse Electric and Manufacturing Company, and after that was engineer in chief for British Westinghouse and Manufacturing Company, London, England. He was an assistant engineer in the electrification of the New York Terminal and Tunnels of the Pennsylvania and Long Island railroads. He became a partner of Gibbs and Hill in 1912.

Ward Dix Kerlin, M.E. '01, retired executive of the Camden, N. J. Forge Company. He joined the Camden Forge Company in 1906 and served as secretary and treasurer until his retirement in 1945. From 1939 to 1945 he was on the board of directors of the Federal Reserve Bank of Philadelphia.



It's springtime 256 times a second

Your doctor counts your pulse beat. The musician calls it rhythm. The sportsman knows it as timing. The engineer, who designed your automobile, refers to it as cycles.

The valves that admit and exhaust the gas to and from your engine are timed to form a cycle.

Spiral springs made of high-carbon round wire play a vital part in maintaining this cycle—in keeping your automobile engine running smoothly—at the torturing rate of 256 spring-actions a second.

Taken for granted today, they were a major headache to the driver of yester-year. Today's springs are as superior to the springs of thirty years ago as are the cars themselves.

Improvements came with demand and competition. No other country advanced as rapidly . . . or as far.

Just as the discovery of America was made possible by enterprise capital, so the automobile was the product of free enterprise—including the cash that buys it.

It's Springtime 256 times a second under your hood and Roebling is proud of its contributions to that engineering feat.

Roebling also is proud of *this* fact: the world over, automobile engineers have confidence in Roebling and its products.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

A CENTURY OF CONFIDENCE **ROEBLING**

Engineering Societies

(Continued from page 19)

eering. All those in or above their sophomore year in chemical engineering are eligible.

At present, the officers are: Earl Nelson, president; Neal James, secretary; and Curt Reinhold, treasurer.

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

American Society Of Civil Engineers

This society attempts to create interest among students in Civil Engineering by holding field trips and presenting movies and lectures for students. The society is planning to expand by communicating with other engineering schools. Also the Northeast conference of Civil Engineers will be held at Union College; and a field trip is being planned to Syracuse. Any student registered in the C.E. school is eligible for membership. Louis N. Fitzsimmons is president; Philip Hollowell, vice-president; William Brown, secretary; Journ T. Lee, treasurer; and Prof. J. Terry is adviser to the group.

GIVE ME A LEVER LONG ENOUGH AND A PLACE TO STAND · CSEP

Cornell Society Of Engineering Physics

The newest engineering society at Cornell, founded a little over a year ago, is the Cornell Society of Engineering Physics. It was formed to foster and to promote fellowship among students, faculty, and alumni of engineering physics at Cornell, and to provide a means of group action and expression for the students in engineering physics. All engineering physics students are eligible to attend meetings, and to become members.

The officers for the coming year are Herb Spirer, president; Bill Jahsman, vice-president; John Gay, treasurer; and Leonilda Altman, secretary.

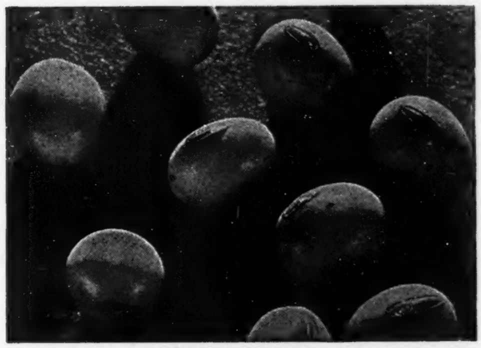
Rod and Bob

This social honorary society is the oldest in the School of Civil Engineering. The general aim of the society is the promotion of good fellowship among members and to make their last years of college life more enjoyable. Also, contact with the various members after graduation is maintained to relay information on jobs and opportunities in the engineering field. Various projects are supported to maintain interest in the Civil Engineering School. A student must be a Junior to become eligible for membership and must be elected by a unanimous vote of the active members. Academic standing and personality are prime qualifying factors. Jack Roberts is president, and Kenneth Bender secretary-treasurer of the organization, which is planning several social functions in the future.

(Concluded on page 50)

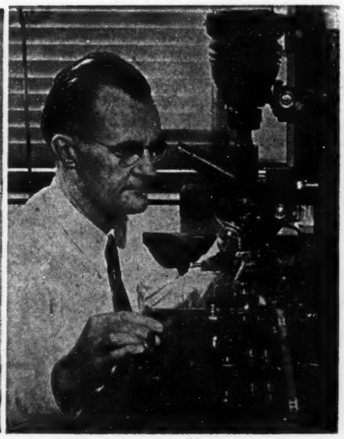
"Chain Reaction"

THE PATTERN FOR TEAMWORK AT P&G

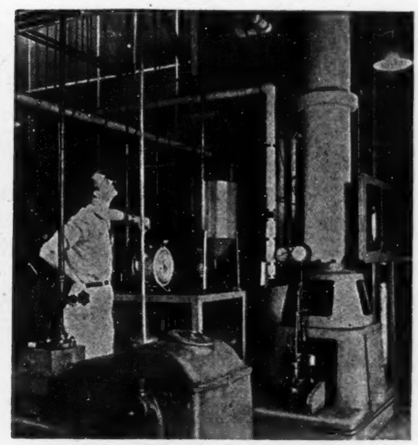


The Versatile Soybean—raw material for many chemical industries — one of many subjects under continuous study at P & G.

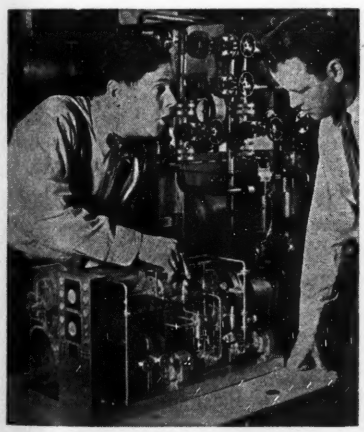
How chemists develop new edible oils . . . and engineers follow through to produce them



1. Chemists conduct microscopic studies on glycerides . . . to develop new edible oils.



2. Chemical Engineers carry on hydrogenation experiments to improve processing procedures.



3. Mechanical Engineers design full-scale factory equipment, using scale models like this edible oil freezer.

4. Other Engineers plan and supervise production operations.

This is just one example of P & G Technical Teamwork in action; similar developments in other fields call for additional men with technical training. That's why P & G representatives periodically visit the country's top technical schools to interview students. If you would like to talk to a Procter & Gamble representative, ask your faculty adviser or placement bureau to arrange a meeting.

PROCTER & GAMBLE

CINCINNATI 1, OHIO

Engineering Societies

(*Continued from page* 48)

Pros-Ops

Pros-Ops was founded at Cornell University during 1947 as an honorary society for students in Chemical Engineering. To be eligible for membership, a student must be in good standing scholastically and must either be participating in athletics or have successfully completed a competition. Its purpose is to promote good fellowship in the Chemical Engineering school, and to foster extra-curricular activities.

Atmos

This honorary engineering society primarily attempts to forward the interests of the Sibley School of Mechanical Engineering. Athletic events are sponsored; and parties promote faculty-student relationships.

Any student, not on probation, and in his junior or senior year is eligible for membership. The present officers of the organization are president, Rodney Miller; vice-president, Ross Worn; secretary, Eugene Hofmann, and treasurer, Charles Read.

Pyramid

The Pyramid Society, founded sixty years ago as a cooperative is designed to promote spirit in the School of Civil Engineering and to discuss matters of interest to civil engineers. The society consists of thirty students plus faculty members. Students are selected each year from those in their last half of their undergraduate careers.

The present officers are Carl Irwin, president; Robert Shumaker, vice-president; Walter Hickey, secretary-treasurer.

College News

Continued from page 32)

steps to establish a Cornell branch of the Institute of Radio Engineers, which could operate in conjunction with the A.I.E.E. There would be a faculty counselor for each organization, and they would also have seperate secretaries. It was emphasized that students could belong to either or both of these organizations.

This consolidation is expected to enlarge the scope of subject matter discussed, and encompass the interests of engineering physics' students as well.

EDITOR'S NOTE:
The article *Color Video Is on the Way* by Mr. Lynn W. Ellis, Jr., E.E. '48, that appeared in the October, 1948, issue of the CORNELL ENGINEER, was written by Mr. Ellis while an undergraduate at Cornell and in no way reflects the views of the technical staff of Federal Tele-communication Laboratories, where he is now employed.

ENGINEERS, like Ralph Hovey, R. P. I. '37 and William Godfrey, Rutgers '44, use supersonic device to test a metal's thickness.

LABORATORY EXPERTS, like Gloria Higgins, make many scientific tests to assure *quality* petroleum products for your use.

CAT CRACKER TESTERS, like A. J. Ely, Lehigh '47 and K. O. Johnson, Minnesota '42, run one of many checking tests at a giant catalytic cracking plant.

THEY'RE what count most with us!

PERHAPS THE MOST important thing behind the Esso Sign is not just the great laboratories and refineries of Esso Standard Oil Company...

No... it's probably just *the people and the kind of jobs they have!*

Workers who have not had an important strike or labor disturbance in over 30 years!... Workers who today average over 14 years with the company!...

Workers with regular, paid vacations each year. Workers with high wage scales and steady work. Workers with retirement on pensions for life. Workers with an opportunity for advancement... because they know there's company training to help them get ahead... because they know *every president of our company has worked his way up!*

Such is the policy of employee benefits at Esso Standard Oil Company... a policy that believes *good jobs draw and hold good workers*... a policy that believes *good people are good business!*

REFINERY WORKERS, like Bill Kohl, help make "Happy Motoring" come true at the famous Esso Sign.

Copies of our booklet, "Your Technical Career" are available at College of Engineering, Directory of University Placement Service, and School of Chemical Engineering.

Esso **ESSO STANDARD OIL COMPANY**

STRESS *and* STRAIN...

Professor: "*What is a bachelor?*"
Quiz Kid: "*A bachelor is a college man who didn't have a car when he was young.*"

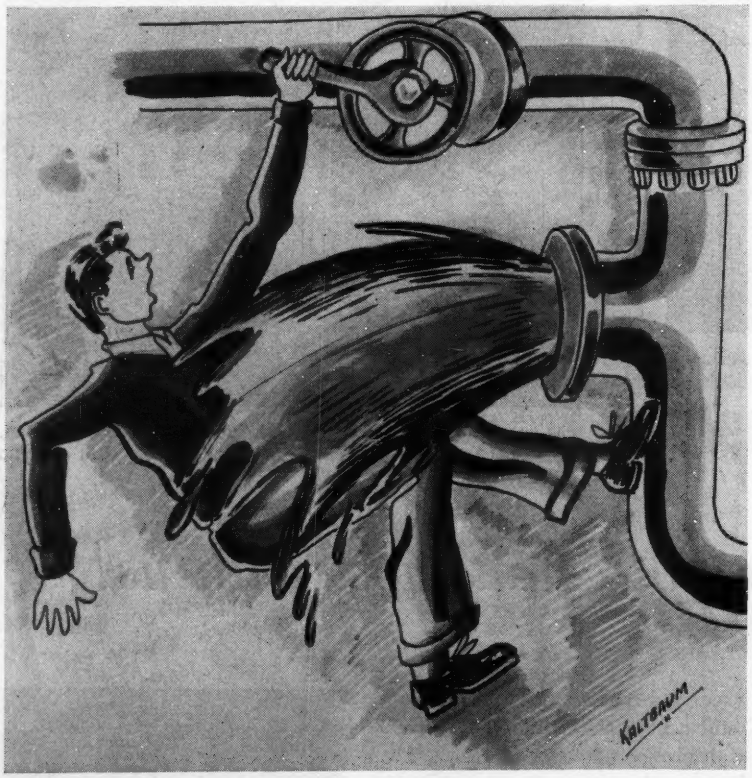
* * *

Student (Reporting to Infirmary): "I'm scared, doctor. This is my first operation."

Surgeon: "I know how you feel. It's my first one, too."

A Frenchman came to London to learn the language and soon got into difficulties with his pronunciation, especially with the group comprising "though," "plough," and "rough."

When the film of "Cavalcade" began its run, and one newspaper review was headed "Cavalcade pronounced Success," the Frenchman went back home.



A delicate experiment in hydraulics . . .

A Los Angeles car owner was having his eyes tested for a driver's license. Pointing to a chart on the wall, the examining officer asked the man to identify the thing he saw.

"What is in the large circle in the center?", he asked.

"That is the figure 81," the man replied.

"Wrong," said the officer, "That is a picture of Mae West talking to Katharine Hepburn."

The lady of the house suspected that one of her two sons had been dating the maid. Anxious to find out which one, she said:

"Nora, if you had the opportunity of going to the movies with one of my sons, which one would you choose?"

"Oh, it's hard to say, ma'am. I've had grand times with both of them. But for a real rollicking spree, give me the master."

As evidence that things are not as they seem, we cite the case of a California engineering student. Driving across the Bay Bridge, he noticed that the San Francisco and Oakland city-limit signs were 50 feet apart. Hastily he entered a claim to the 50 foot gap. And just as hastily he dropped it when another engineer explained quietly that there weren't two border lines —just one. It ran through the bridge diagonally and there wasn't an inch to spare.

—*This Week Magazine*

* * *

The husband eyed his wife over the hotel dinner table in puzzled surprise, "That's a beautiful necklace you're wearing, my dear," he said.

"Yes, isn't it, darling?" replied the wife. "I found it in the back of your car."

* * *

A hug is a thing of beauty entirely surrounded by a stretch of masculinity.

* * *

There is a yarn about the general who had to take his staff to task for over-indulgence in alcohol.

"Nobody minds a man having a morning eye-opener," he told them. "And it's okay to have a bracer around 10 o'clock and a couple of drinks before lunch. And I think a few beers on a hot afternoon keep a man healthly. Then comes the cocktail hour; everybody drinks then. And you can't criticize a man for having wine with his dinner, a liquor afterward, and several highballs during the evening. But this business of SIP, SIP, SIP all day long has got to stop!"

* * *

He: "You're Mae West, aren't you?"

She: "I should say not! I'm June West, thirty days warmer than Mae."

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